THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXXV. No. 1931.] LONDON, MAY 15, 1900. [52ND YEAR. PRICE 6d.

TROTTER, HAINES, & CORBETT,
Brettell's Estate
FIRE-CLAY & BRICK WORKS,
STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.
Proprietors of
BEST GLASSHOUSE POT & CRUCIBLE CLAY.
SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.

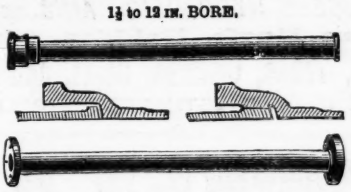
LONDON OFFICE: R. CULL, 84, OLD BROAD STREET, E.C.

HEBBURN MAIN GAS COALS.

Yield of Gas per Ton .	10,500 Cubic Feet.
Illuminating Power . . .	16·4 Candles.
Coke	68 per Cent.

For Prices, f.o.b. Ship or Delivered by Rail, apply to
The Wallsend & Hebburn Coal Company, Ltd.
B Lombard Street,
NEWCASTLE-ON-TYNE.
W. RICHARDSON, Fitter.

GAS AND WATER PIPES
1¼ to 12 IN. BORE.



THOMAS ALLAN & SONS,
Bonlea Foundry,
SOUTH STOCKTON-ON-TEES.
Formerly Springbank Iron-Works, Glasgow.
ESTABLISHED 1848.
ALSO MANUFACTURERS OF
SANITARY & RAIN-WATER PIPES, HOT WATER PIPES, STABLE FITTINGS, RANGES, STOVES, And GENERAL CASTINGS.
Telegrams: "BONLEA, STOCKTON-ON-TEES."

PARKER & LESTER,
Manufacturers & Contractors.
GAS-LEAK INDICATOR.
For Particulars and Price apply to
ORMSIDE STREET, LONDON, S.E.

ESTABLISHED 1830.

ROBERT MARSHALL,
CANNEL COAL MERCHANT,
97, WELLINGTON STREET, GLASGOW.
Prices and Analysis of all the Scotch Cannels on Application.

CARLESS, CAPEL & LEONARD,
HOPE CHEMICAL WORKS, HACKNEY WICK, LONDON, N.E.,
And at Pharos Works, Hackney Wick.
NAPHTHA AND GASOLINE DISTILLERS AND PETROLEUM IMPORTERS,
Specially distil Carburine Spirit, specific gravity ·680, or of any other grade suitable for Enriching Gas; also Gas Oil best adapted for injecting into the Retorts, as in the Herring Process.
Importers of Petroleum for Carburetting Water Gas, or for Manufacturing Oil Gas. Distillers of Pentane, Petroleum Ether, and Naphtha for clearing the pipes of Naphthaline, &c.
Samples and Prices may be had on application.

THE Utilization of Towns' Refuse for some practical purpose has been successfully solved; and there is, therefore, no reason why every township should not have its own Electric Light Installation, and obtain the power from its Dust-Bins.

MELDRUM SIMPLEX DESTRUCTOR.

ORDERS NOW ON HAND—
DARWEN, LANCS., 8 cells; 2 Lancashire Boilers, 30 feet by 8 feet—200 lb. pressure.
SHIPLEY, YORKS., 4 cells; 1 Lancashire Boiler, 30 feet by 8 feet.
HUNSTANTON WATER-WORKS, BURTON, BLACKBURN, &c., &c.

At Hereford City the Sewage Farm is now worked entirely with power from refuse, 1¼ million gallons being pumped per day, besides working Sludge-Presses, Sludge-Pumps, and Lime-Mixers—the saving in Cost of Coal (not now used) being about £300 per annum.

Write for full Particulars, stating Weight of Refuse per annum, and for what purpose you would wish to use the Power, when we shall be glad to submit a suitable Scheme.

MELDRUM BROS., ATLANTIC WORKS, **MANCHESTER.**

DANIEL HOWARD,

(Successor to the late BENJ. WHITEHOUSE),

GASHOLDER & BOILER WORKS,

WEST BROMWICH, NEAR BIRMINGHAM

(ESTABLISHED 1765).

MANUFACTURER OF TELESCOPIC AND SINGLE GASHOLDERS,

WROUGHT AND CAST IRON TANKS FOR DITTO,

PURIFIERS, CONDENSERS, SCRUBBERS, HYDRAULIC MAINS, and all kinds of GAS APPARATUS,

Wrought-Iron Roofs, Bridges, Girders, &c.,

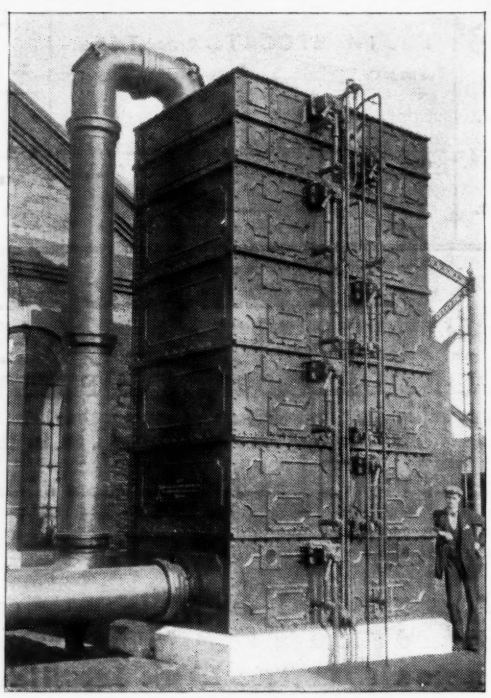
Steam, Hot Water, and Range Boilers, Tanks, Cisterns, Boats, and all kinds of Wrought-Iron Work.

DRAWINGS, SPECIFICATIONS, AND ESTIMATES SUPPLIED ON APPLICATION.

EDWARD COCKEY & SONS, LTD.

Washer-Scrubber capable of passing **1 MILLION CUBIC FEET OF GAS PER DAY,** With Graduated Seal Regulators.

As erected by us at the GAS-WORKS, RYDE.



Has no moving parts, and cannot get out of order.

Can be made any shape to suit space available.

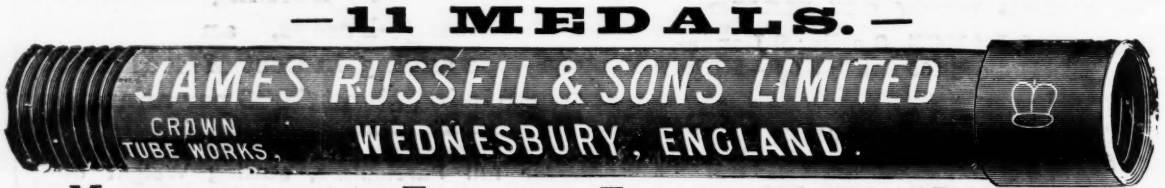
Telegraphic Address:
"COCKEYS, FROME."
Telephone No. 16.

THE IRON-WORKS, FROME, SOMERSET.

London Agents:
Messrs. BALE & HARDY,
Bridge House,
181, Queen Victoria St., E.C.

HIGHEST AWARDS—LONDON, PARIS, COLOGNE, VIENNA, MELBOURNE, AND OTHERS.

—11 MEDALS.—



MANUFACTURERS OF TUBES AND FITTINGS OF EVERY DESCRIPTION.

WROUGHT-IRON OR STEEL MAINS UP TO 6 FEET DIAMETER, FOR GAS, WATER, OIL, OR OTHER PURPOSES.

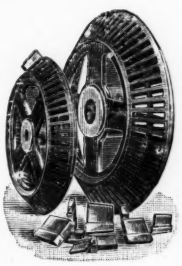
SCREWING TACKLE, BOILER MOUNTINGS, VALVES, COCKS, ETC.

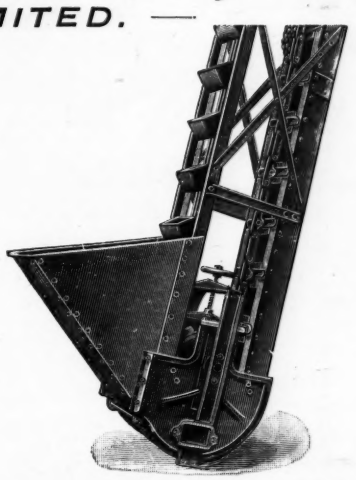
LONDON: 108, Southwark Street.
MANCHESTER: 33, King Street West.
BIRMINGHAM: 114, Colmore Row.
LEEDS: 6, Mark Lane, New Briggate

BARRY, HENRY, & CO.,

— LIMITED. —

Specialities:
TRANSMISSION OF POWER.
Rope and Belt Pulleys,
Spur and Bevel Wheels,
Shafting and Couplings,
Pedestals, and Fixings.





Specialities:
TRANSMISSION OF MATERIALS.
Conveyors
Elevators,
Grinding Machinery,
Motors.

WORKS:
ABERDEEN,
SCOTLAND.

AND
64, MARK LANE,
LONDON, E.C.

Telegrams: "Robustness, London."

RETORT-HOUSE, SETTINGS, & RAILWAY

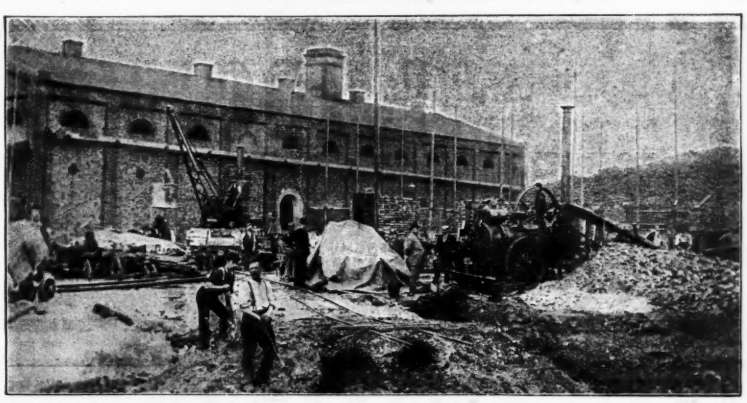
Telephone: No. 756 Bank.

IN COURSE OF ERECTION BY OUR OWN WORKMEN.

Plans, Estimates, and Specifications prepared and submitted.

Special Facilities for RECONSTRUCTING GAS-WORKS.

CONDENSERS,
SCRUBBERS,
WASHERS,
EXHAUSTERS,
TANKS,
and every
REQUISITE.

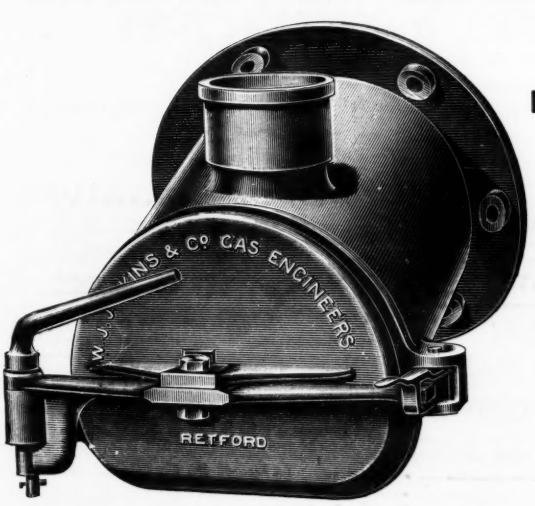


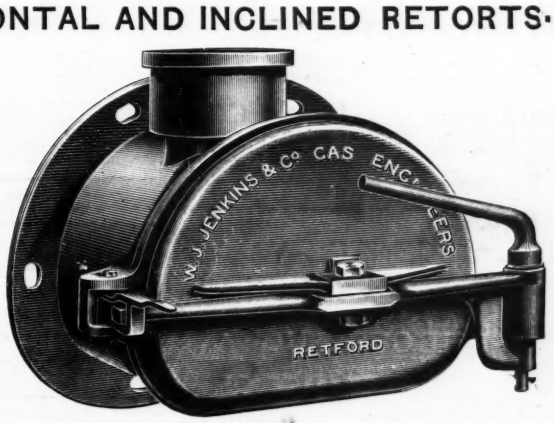
A SPECIALITY.
INCLINED and FLOOR-LEVEL SETTINGS, with or without REGENERATIVE or GENERATOR FURNACES, with or without IRONWORK.
COMPLETE RE-SETTING.

J. & H. ROBUS, Engineers and Contractors, 20, BUCKLERSBURY, LONDON, E.C.
GASHOLDER TANKS AND MAIN LAYING.

MOUTHPIECES

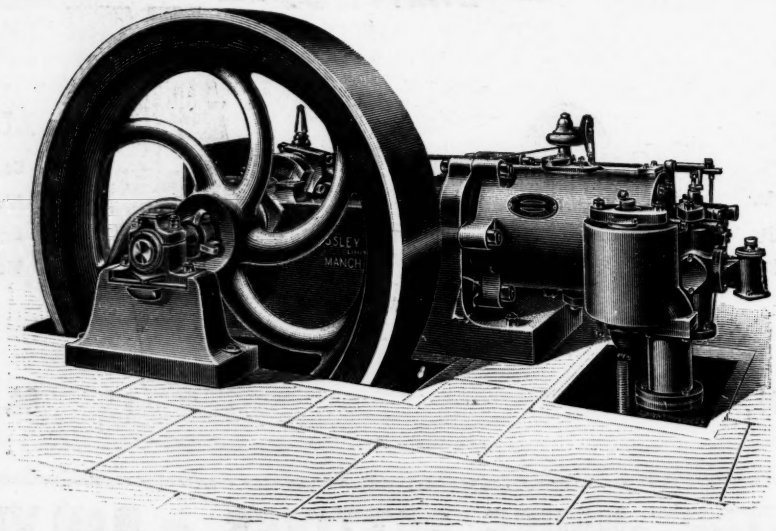
WITH SELF-SEALING LIDS FOR HORIZONTAL AND INCLINED RETORTS.





W. J. JENKINS & CO., LTD., RETFORD.

CROSSLEY'S GAS-ENGINES



Represents W.E. Type and X.E. Type High-Speed Electric Light Engines of 52 and 64 Effective Horse Power.

CROSSLEY BROS., LTD., OPENSHAW, MANCHESTER.

LOCOMOTIVES

LOCOMOTIVES of all Sizes and Gauges specially constructed for Main and Branch Lines, Contractors, Docks, Gas-Works, Collieries, Iron-Works, Brick and Cement Works, &c. Locomotives of various Sizes always in Stock, ready for Immediate Delivery.

Photographs, Specifications, and Prices on Application.

PECKETT & SONS, Atlas Locomotive Works, BRISTOL.

Telegraphic Address: "PECKETT, BRISTOL."

NEWTON, CHAMBERS, & CO.,

LIMITED,

THORNCLIFFE IRON-WORKS, NEAR SHEFFIELD.

Established 1790

LONDON OFFICE: 19, Great George Street, WESTMINSTER.

Telegraphic Addresses: "NEWTON, SHEFFIELD," "ACCOLADE, LONDON."

GAS ENGINEERS, IRONFOUNDERS, & CONTRACTORS.

Manufacturers of every description of

PLANT, APPARATUS, and MACHINERY for GAS and CHEMICAL WORKS.

RETORTS and FITTINGS, MOUTHPIECES with Self-Sealing Lids.

Improved COAL and COKE HANDLING PLANT, CONVEYORS, and ELEVATORS,

CONDENSERS, SCRUBBERS, and WASHERS.

PURIFIERS with Planed Joints a Speciality.

Patent CENTRE-VALVES, RACK and SCREW VALVES, WOOD GRIDS, and SCRUBBER-BOARDS, CAST-IRON MAINS, and SPECIALS.

STRUCTURAL WORK, COLUMNS, GIRDERS, and ROOFING.

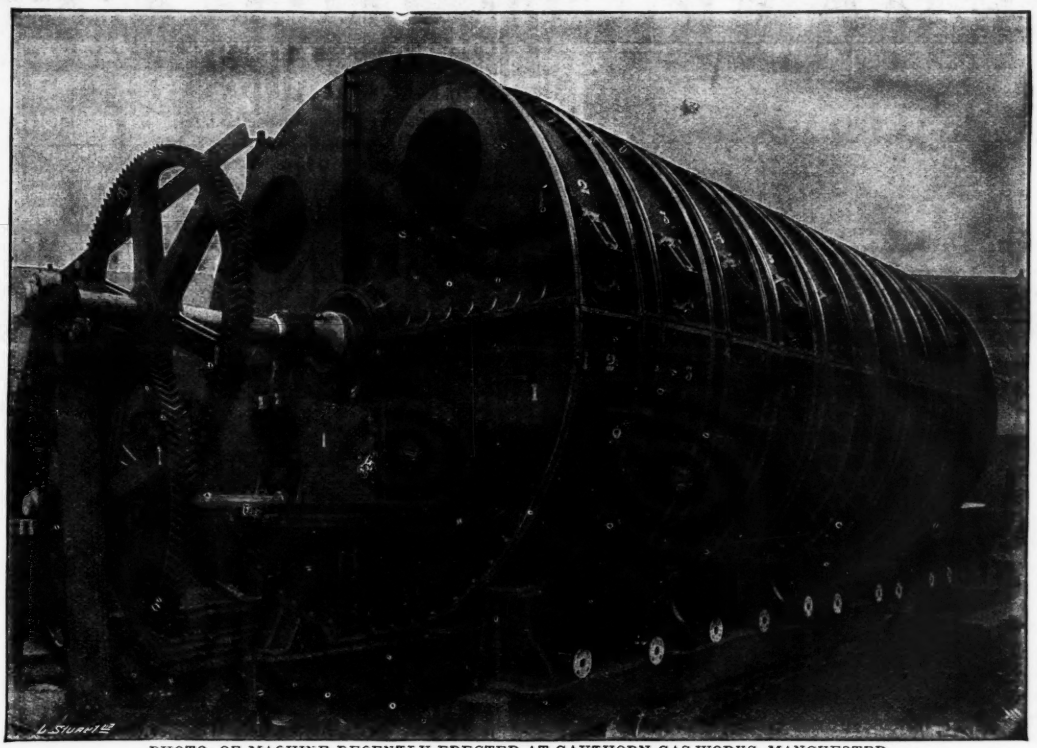
GASHOLDERS, Cast-Iron or Steel Tanks.

DESIGNS, SPECIFICATIONS, and ESTIMATES FREE.

PIG IRON (Special Quality) for Engine Cylinders, GAS COAL famous for its UNRIVALLED EXCELLENCE.

PATENT "NEW" SCRUBBER-WASHER.

RESULTS GUARANTEED.



RESULTS GUARANTEED.

PHOTO. OF MACHINE RECENTLY ERECTED AT GAYTHORN GAS-WORKS, MANCHESTER.

NOTE: Orders already received in 1900 for MACHINES to deal with 30,300,000 cubic feet of Gas per Diem.

PATENTEES AND SOLE MAKERS: **W. C. HOLMES & CO.,** WORKS: **HUDDERSFIELD.**

Telegrams: "HOLMES, HUDDERSFIELD." **Contractors to Her Majesty's Government.** Cablegram: "IGNITOR, LONDON."

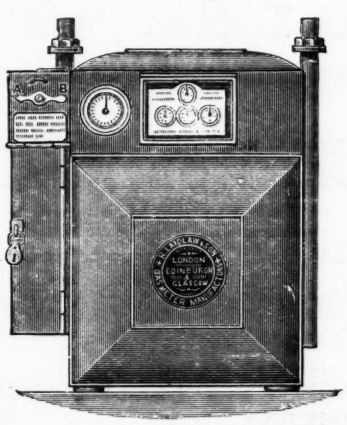
R. LAIDLAW & SON

GAS & WATER ENGINEERS.

MANUFACTURERS OF WET & DRY GAS-METERS,

SIEMENS WATER-METERS,

PREPAYMENT GAS-METERS.



—DRY METER.—

—WET METER.—

EDINBURGH: SIMON SQUARE WORKS. | **GLASGOW:** ALLIANCE FOUNDRY. | **LONDON:** 6, LITTLE BUSH LANE.

FRANK WRIGHT'S

PREPAYMENT GAS-METER CORPORATION, LIMITED,

Dry Gas-Meter Manufacturers.

THE ADVANTAGES OF THIS SYSTEM ARE--

1. Simplicity of Mechanism.
2. Absolute Accuracy.
3. Impossibility of being Tampered with.
4. Unaffected by any irregularities in shape or thickness of the penny.
5. Can be fixed to any ordinary Dry Meter.
6. Extra large Money-Box.
7. Price Changer can be altered without otherwise disturbing Meter.
8. Index showing the number of Pennies in the Mechanism at any time.
9. Rejection of Half-Pennies certain.

The Trafalgar Prepayment Gas-Meter (Forster's Patent.)

Guaranteed for Five Years.

Offices and Works: 62, GLENGALL ROAD, S.E.

Telegraphic Address: "GASOMETER, LONDON." Telephone No. 1259 HOP.

AMERICAN GAS OIL

SOLE IMPORTERS—

ANGLO-AMERICAN OIL COMPANY, LIMITED.

This well-known quality of Oil is used at most of the Corporation Works and Companies' Works throughout the United Kingdom. Contracts have also been entered into with several of the large Railway Companies.

LARGE STOCKS. PROMPT DELIVERY.

Stock of about 30,000 Tons is usually carried by us at our Installations at Avonmouth, Birkenhead, Barrow, Manchester, and London.

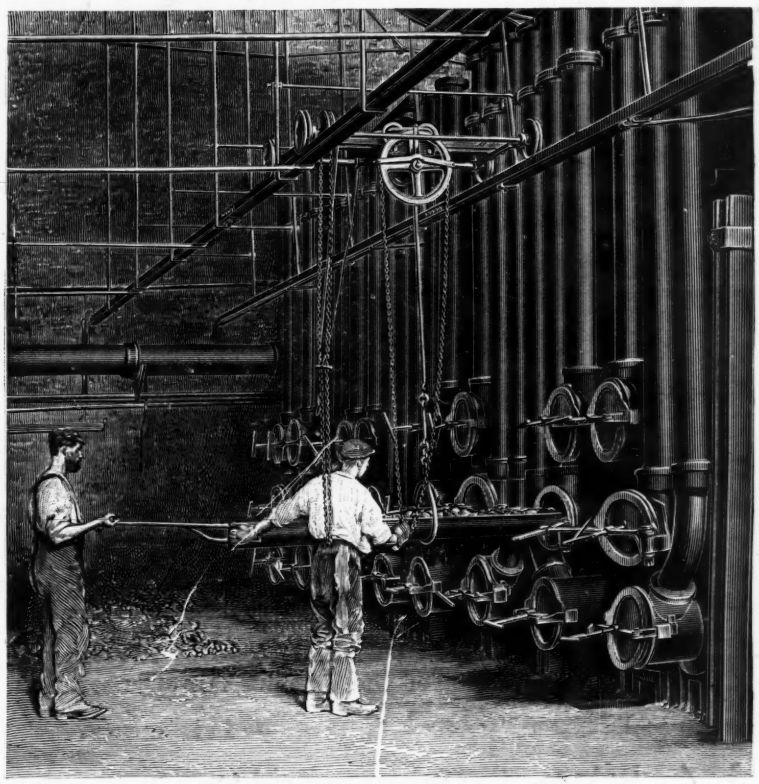
HEAD OFFICE:

22, BILLITER STREET, LONDON, E.C.

BIGGS, WALL, & CO.

THE
"RAPID"
MANUAL
CHARGING
APPARATUS.

JUST ERECTING
"RAPID"
CHARGING
MACHINES
At the following Places:
Four Machines at
NEWPORT (Mon.)
One Machine at
KIRKCALDY.
Four in the
COLONIES.



4 CWT. CHARGE
TAKES LESS
THAN
ONE MINUTE.

Telegraphic Address:
'Ragout, London.'

13,
CROSS ST.,
FINSBURY,
LONDON,
E.C.

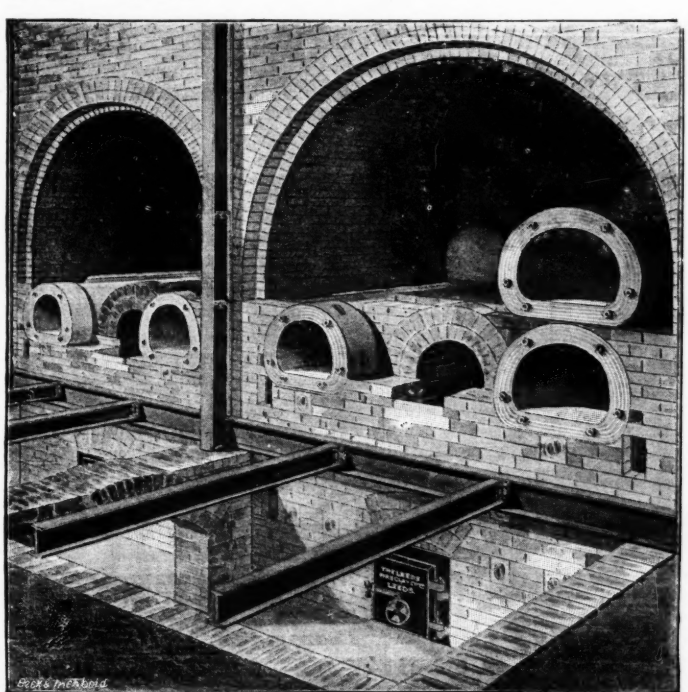
THIS MACHINE CAN BE SEEN AT WORTHING AND TRURO GAS-WORKS.

THE LEEDS FIRE-CLAY CO., LD.,

ENGINEERING
DEPARTMENT

Telegrams:
"SETTINGS, LEEDS."
Telephone: No. 1332.

WORTLEY, LEEDS.



Engraved from a Photograph taken during Construction of our Shallow Regenerator Settings.

RETORT-SETTINGS

OF EVERY DESCRIPTION
INCLINED, HORIZONTAL,
REGENERATOR, GENERATOR,
and DIRECT FIRED.

SHALLOW REGENERATORS
A SPECIALITY
MANY INSTALLATIONS.
EXCELLENT RESULTS OBTAINED.

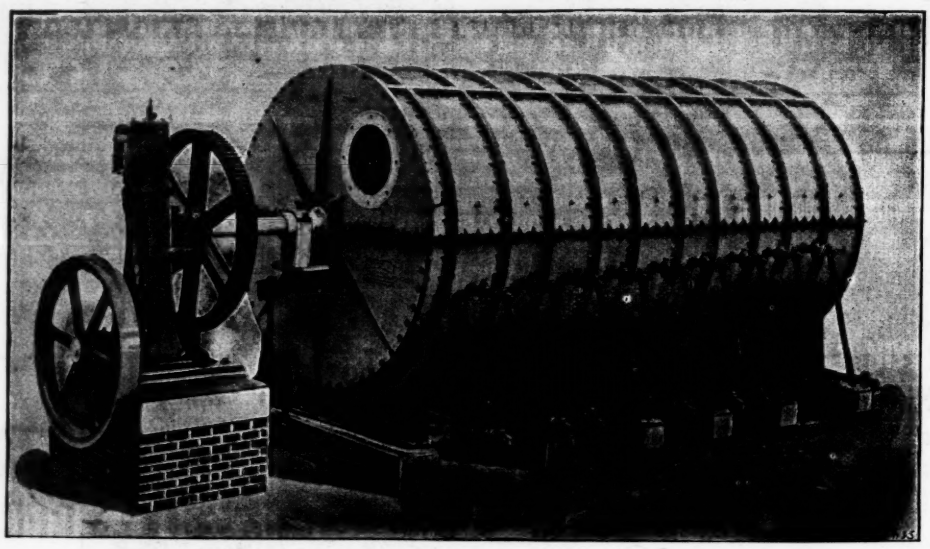
RETORTS RE-SET.
RETORT IRONWORK.
COAL AND COKE-BREAKING
AND CONVEYING MACHINERY.
BUILDINGS, ROOFS, &c.

KIRKHAM, HULETT, & CHANDLER, LD.

PATENT "STANDARD" WASHER-SCRUBBERS

Complete Extraction of Ammonia and large proportion of CO_2 and H_2S.

Maximum Strength Liquor produced, Minimum Water Supply and Driving Power required.



Old Pattern Machines fitted with latest Improvements at Small Cost.

PATENT "STANDARD" WASHER-SCRUBBER (one of two) recently erected at the Devon Street Works of the Birmingham Corporation.

Nearly 600 in use.

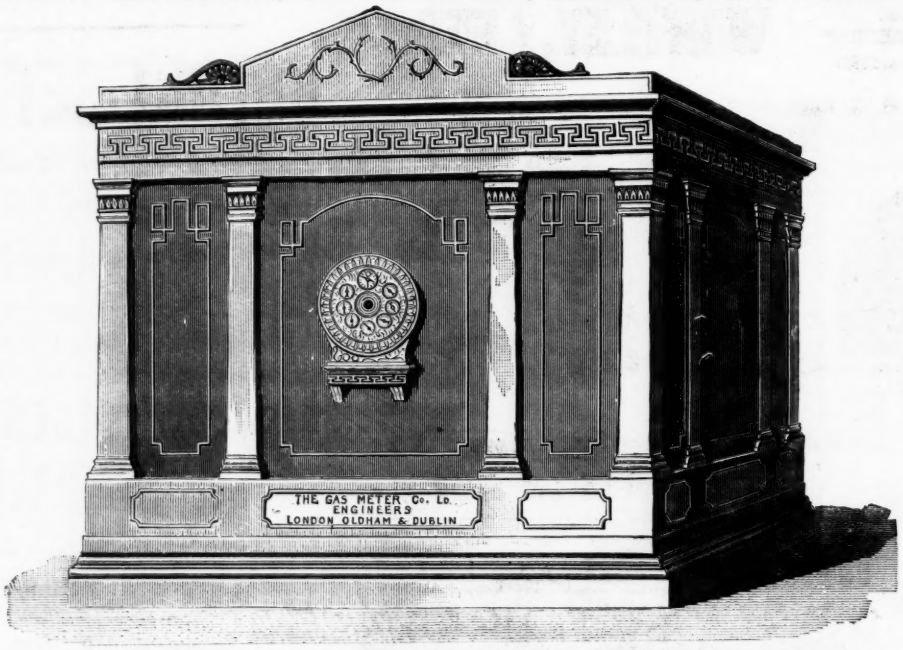
Address: 3 & 4, Palace Chambers, Bridge Street, Westminster, S.W.

THE GAS-METER COMPANY, LIMITED.

MANUFACTURERS OF

WET AND DRY GAS-METERS, STATION METERS, GOVERNORS, GAS APPARATUS, ETC.

SQUARE STATION METERS WITH PLANED JOINTS.



STATION METERS IN CYLINDRICAL CASES.

DESIGN No. 2 PATTERN.

STATION METERS MADE AT THE COMPANY'S WORKS, OLDHAM (Late WEST & GREGSON). Established 1830.

Prices and Particulars apply to

R. L. ANDREWS, General Manager.

Works: 238, KINGSLAND ROAD, LONDON; UNION STREET, OLDHAM; HANOVER STREET, DUBLIN.

Telegraphic Address: "METER."

[See Advertisement on back of Wrapper.

HUMPHREYS—GLASGOW

CARBURETTED WATER-GAS PLANT

These instances are all from the LONDON designs of Messrs. HUMPHREYS & GLASGOW.

	Cub. Ft. Daily.		Cub. Ft. Daily.		Cub. Ft. Daily.
Copenhagen	700,000	Coventry	600,000	Lawrence, Mass.	400,000
Copenhagen (Second)	2,500,000	Coventry (Second)	600,000	Commercial Gas Co.	850,000
Belfast	1,700,000	Bordentown, N.J.	125,000	Commercial (Second)	850,000
Belfast (Second)	4,500,000	Winchester	225,000	Commercial (Third)	1,250,000
Brussels	750,000	Shanghai	225,000	Rotterdam	850,000
Brussels (Second)	750,000	Stockport	600,000	Dorking	150,000
Liverpool	3,500,000	Norwich	1,000,000	McKeesport, Pa.	500,000
Liverpool (Second)	4,500,000	Holyoke, Mass.	600,000	G.L.&C.Co., Bromley	3,750,000
Tottenham	750,000	St. Joseph, Mo.	750,000	G.L.&C.Co., Nine Elms.	2,750,000
Tottenham (Second)	750,000	Lea Bridge	350,000	Durham	200,000
Santiago de Cuba	400,000	Lea Bridge (Second)	350,000	New York	4,000,000
Swansea	750,000	Stockton-on-Tees	500,000	Scarborough	800,000
Manchester	3,500,000	Edinburgh	2,000,000	Perth, W.A.	125,000
Brighton	1,750,000	Guildford	350,000	Bremen	550,000
Preston	1,400,000	Brentford	1,200,000	Maidenhead	225,000
New York	1,200,000	Syracuse, N.Y.	850,000	Epsom	225,000
Southport	750,000	Bridlington	150,000	North Middlesex.	150,000
Bath	1,000,000	Middlesbrough	1,250,000	Wandsworth.	1,800,000
Newburg, N.Y.	350,000	Croydon	1,250,000	Aarhus	800,000
Newburg (Second)	250,000	L. & N.W. Ry., Crewe	700,000	Falmouth	150,000
Hoylake	125,000	Taunton	225,000	Southampton	800,000

SINCE JANUARY 1ST, 1899.

Hartlepool	750,000	Brussels	1,000,000	Staines	600,000
Utrecht	1,000,000	Brighton (Second)	1,850,000	Commercial (Fourth)	2,000,000
Deventer	150,000	Stockport (Second)	600,000	Dublin (Second)	2,000,000
Portsmouth	1,000,000	Croydon (Second)	625,000	Faversham	200,000
Bournemouth	1,000,000	Maidenhead (Second)	225,000	Birmingham (Swan V'ge)	1,500,000
Aylesbury	150,000	G.L.&C.Co., Beckton	2,250,000	St Gallen (Switz.)	225,000
Hamburg	1,750,000	G.L.&C.Co., Fulham	1,750,000	Colney Hatch	400,000
Redhill	275,000	Tottenham (Third)	350,000	Southampton (Second)	500,000
Dublin	2,000,000	Sydney (Harbour)	500,000	Tunbridge Wells	1,000,000
Posen	450,000	Sydney (Mortlake)	500,000	Hebden Bridge	200,000
Dunedin (N.Z.)	150,000	Manchester (Second)	3,500,000	Chorley	300,000
Lincoln	500,000	Hull	1,500,000	Liège	1,000,000
Antwerp	1,500,000	Longton	600,000		

[The 1891 Installations of The Gaslight and Coke Co., 12,000,000 Cubic Feet Daily.]

Total Capacity above 116,300,000 Cubic Feet Daily.

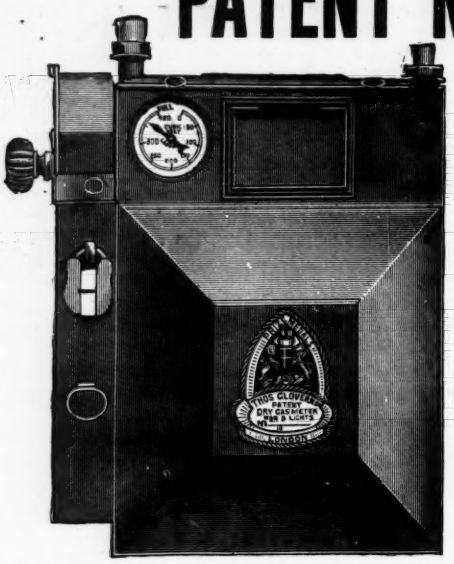
United States Total 236,800,000 Cubic Feet Daily.

Grand Total - 353,100,000 Cubic Feet Daily.

9, VICTORIA STREET, LONDON, S.W.
Telegrams: "EPISTOLARY, LONDON."

UNITED STATES OFFICE:
BANK OF COMMERCE BUILDING, NEW YORK.

THOMAS GLOVER & CO.'S PATENT NEW IMPROVED PREPAYMENT METER



For Pennies, Shillings, or any Coin.

Simple in Mechanism.
Positive in Results.
Price Changer *in Situ.*

GUARANTEED FOR FIVE YEARS.

Telegraphic Address: "GOTHIC, LONDON." Telephone No. 725, Holborn.

THOMAS GLOVER & CO., LTD.,
DRY GAS-METER MANUFACTURERS,
214 TO 222, ST. JOHN STREET, CLERKENWELL GREEN, LONDON, E.C

BRISTOL:	BIRMINGHAM:	MANCHESTER:	GLASGOW:
28, BATH STREET.	1, OOZELLS STREET.	37, BLACKFRIARS STREET.	69-71 McALPINE STREET.
Telegraphic Address: "GOTHIC."	*Telegraphic Address:* "GOTHIC."	*Telegraphic Address:* "GOTHIC."	*Telegraphic Address:* "GASMAIN."
Telephone No. 1008.		Telephone No. 8398.	Telephone No. 6107.

W. PARKINSON & CO.

WET & DRY GAS-METERS

OF

SUPERIOR QUALITY.

GUARANTEED FOR

5 YEARS.

COTTAGE LANE WORKS, CITY ROAD,
LONDON.
Telegrams: "INDEX." Telephone No. 778 King's Cross.

BELL BARN ROAD WORKS,
BIRMINGHAM.
Telegrams: "GASMETERS." Telephone No. 1101.

[See also Advt. on last White Page.

CONTENTS.

EDITORIAL NOTES:—

GAS, LIGHTING, &c.— PAGE.

Rejection of the Portable Photometer Bill. 1271
The Prepayment Meter Part of the London County Council Bill. 1272
The Gaslight and Coke Company's Bill in Committee 1272
Concerning an Export Duty on Coal 1272
The Coal and Iron Markets 1273
Examinations in Gas Manufacture 1273
The Fall in Gas Stocks 1274
Illicit Commissions Exposed. 1274
Housing the Working Classes of Towns 1275

INSTITUTION OF GAS ENGINEERS:—

GENERAL MEETING IN LONDON—

Papers and Discussions (*concluded*)—
Inclined Retorts at Bankside. By C. C. Carpenter 1275
The Presence of Naphthalene in Coal Gas: Its Detection and Extraction. By Wilfred Irwin 1282
Notes on Carbonizing Cannel and Shales for Gas-Making Purposes. By S. Glover. 1286
Some Examples of Tank Construction. By F. W. Stevenson . 1290
An Experiment with a Concrete and Expanded Metal Structure. By A. Baker 1292

ESSAYS, COMMENTARIES, AND REVIEWS:—

Gas and Water Companies in the Stock Markets 1294
Electric Lighting Memoranda 1294
On the Tyranny of the Laboratory 1294
The Press and the High Price of Coal 1295
Recent Publications—"Iron Corrosion, Anti-Fouling, and Anti-Corrosive Paints;" "The Boroughs of the Metropolis: A Handbook to Local Administration in London under the London Government Act, 1899;" "Elementary Practical Physics;" "Elementary Practical Chemistry and Qualitative Analysis;" "Introduction to Physical Chemistry" 1296

NOTES:—

The Use of Oil for Laying Dust 1297
Collapse of a Concrete Bridge in Paris. 1297
Proper Position of Air Inlets and Outlets for Ventilation . . . 1297
Krypton 1298

COMMUNICATED ARTICLE:—

The Question of an Export Duty on Coal. By a Correspondent. 1298

TECHNICAL RECORD:—

The Incandescent Gas Mantle and Its Use. By Vivian B. Lewes, F.I.C., F.C.S. 1299
The De Brouwer Coke Conveying and Elevating Plant at the Crystal Palace Gas-Works 1302
The Manufacture and Application of Water Gas. By Carl Dellwik. 1303

CORRESPONDENCE:—

Mr. Carpenter's Paper on Inclined Retorts 1305
The Paris Exhibition 1305
Progress in Gas Matters 1306

PARLIAMENTARY INTELLIGENCE:—

Gleanings from the Committee Rooms. 1306
House of Commons Committees—
The Gaslight and Coke, Commercial Gas, and South Metropolitan Gas Companies Bill 1307
The Gaslight and Coke Company Bill 1313

LEGAL INTELLIGENCE:—

The Final Stage in the Sutton, Southcoates, and Drypool Gasholder Case 1318
Central Criminal Court—Regina *v.* Norris; Serious Charge of Falsification of Accounts 1318
Unprotected Trenches 1318
Embezzlement by a Sheffield Gas Collector 1318

MISCELLANEOUS:—

Intensified Gas Lighting in Leeds 1319
Meeting of the Bombay Gas Company, Limited 1319
Dukinfield Gas Department—The Past Year's Working . . . 1319
Burslem Corporation Gas Supply 1319
Electric Lighting Notes 1320
Gas and Water Companies' Stock and Share List 1320
Notes from Scotland 1322
Current Sales of Gas Products 1323
Coal Trade Reports 1324

PARAGRAPHS:—

PERSONAL: Mr. W. H. Maxwell, Assoc.M.Inst.C.E.; Mr. H. C. Page; Mr. Walter Grafton; Mr. Andrew Dougall; Mr. Edward Sandeman. 1297
OBITUARY: Mr. Thomas Burt Haywood; Mr. Edward Willis; M. Eugéne Breittmayer 1297
A Lecture on "Artificial Lighting" 1275
Sunday Labour in Gas-Works—The Association of Gas and Water Engineers of Austria-Hungary 1293
The Visit of Gas Engineers to Woolwich Arsenal—German Association of Gas and Water Engineers 1298
The Wath and District Gas Company's Provisional Order . . . 1323
The Gas and Water Finances of Loughborough—Local Authorities and Incandescent Gas Lighting 1324
Suggested Advance in Price at Manchester—Gas Consumers' Complaints at Birmingham—Gas-Works in the Market—The Price of Gas at Totnes—Sales of Shares. 1325
Carburetted Water-Gas Plant for Oldham—Liverpool Gas-Fittings Company, Limited—Bathurst (N.S.W.) Gas Supply—Stratford-on-Avon Gas Committee and the Rates—Water-Works Extensions Required at Harrogate—A New Gasholder for Maidstone—Ipswich Corporation Water Department 1326
The Purchase of the Gainsborough Gas-Works—The Profits of the Heywood Gas Department—Retrospective Increases in Price—Mid-Sussex Water Supply—The Geltsdale Water-Works for Carlisle—Incandescent Street Lighting at Plymouth—The "Builder" Condemns the London County Council Testing Bill 1327
The Bolton Corporation Water-Works—The Cape Town District Water-Works Company and the Municipalities—The Honley District Council and the Gas-Works—Water under Cost Price to Large Consumers at Bradford—Bridgnorth Gas Supply and Electric Lighting—Evesham Corporation Gas Supply—Wallasey Water Supply—North Warwickshire Water Supply 1328

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

EDITORIAL NOTES.

Rejection of the Portable Photometer Bill.

THE rejection by a House of Commons Committee, after an exhaustive hearing, of the proposal of the London County Council to establish an auxiliary system of penalty testing of London gas by the means of portable photometers, is to be hailed as a notable act of deliverance of the gas industry of these kingdoms from what would have been intolerable and disastrous tyranny. Conceived in officialism, fostered by bureaucratic meddlesomeness, and nurtured upon the blindest obscurantism, the Portable Photometer Bill of the London County Council was one of the most mischievous of all the uncalled-for projects of legislation which this disappointing body have yet fathered. Reactionary to a degree, hopelessly contradictory of every dictate of the most enlightened intelligence, native and foreign, which has been occupied of late years with, and is still concentrated upon, the practical problem of making the very most and best use of town's gas as an aid to the advancement of material civilization, this proposal had just that colouring of plausibility which rendered it an attractive bait for those narrow-minded and short-sighted busybodies who style themselves "Progressives" in parish politics. Unquestionably it sounds perfectly fair and reasonable that every gas consumer in the length and breadth of London, or of any other gas district, should have supplied to him, wherever he wants it, town's gas of the illuminating power required by the Act of Parliament regulating the undertaking for the particular area. This contention being established, what more natural than that the Local Authority should ask to be empowered to see that the obligation is duly discharged? And how can this be done better than by testing the illuminating power of the gas anywhere and everywhere, by a proper and suitable instrument duly certified as a fit and accurate appliance by competent and impartial authority, and used in a fair and proper manner? This was the plea preferred by the London County Council; and a stiff one it was to meet with an uncompromising negative, on the face of things.

Besides, this *primâ facie* case for peripatetic photometrical testing, as it might have been stated at the beginning of the practice of examining town's gas for illuminating power, was supported by evidence carefully prepared to prove that the actual system, of testing only at fixed stations, is unsatisfactory in its results. One of the Gas Referees (Mr. Vernon Harcourt), whose duty it is to see that the existing system is adequately and properly applied for the protection of the consumer, and who can with this object appoint as many testing-places as they choose, gave it as his opinion that the system is no guarantee that the gas supplied all over the district is up to the parliamentary standard. Several capable photometrists carried the case for supplementary testing a point further, by bearing witness to the fact that the gas commonly supplied to Board Schools and other buildings of a public character is not, as a rule, of so high an illuminating power, as shown by a portable photometer, as the gas at the statutory testing-places. It was also proved that the instrument employed to make these peripatetic tests is identical with that used at some of the regular testing-stations; and Mr. Vernon Harcourt himself said that he thought the conditions for the fair use of such an instrument could be satisfactorily prescribed. Other witnesses declared that they could see no reason why the gas in every house in London should not be of the same illuminating power as that found at the official testing-stations.

Having regard to all this portentous mass of presumption, assertion, opinion, and insinuation, it may be freely conceded that the onslaught on the London Gas Companies was not a contemptible one. If the cause had come before a tribunal composed of men who are carried away by the first tale they hear, so that their original state of innocence passes at a bound into bondage to a set prejudice—we have all met such men on juries—then the fate of the gas consumers of London would have been hard indeed. Happily, Parliament was justified by this Committee; and when the turn of the real gas experts came, their evidence crushed out flat the entire fabric which the promoters of the Bill had so laboriously erected. This fabric rested partly upon a distinct imputation of fraud, or double-dealing on the part of the Gas Companies. The promoters shrank from the responsibility of making this charge against the Companies or their officers, but a large bulk of the evidence offered had no other meaning. All

this part of the case quickly went to the winds. Next, the disparity between testings inside and outside the official stations was shown to be a matter of sampling and conditions of experiment. The idea suggested, rather than put in form, to the Committee, that 16-candle gas, or gas of any other illuminating power, is an entity like beer or butter, always to be had on tap, "of the nature and quality de- "manded by the purchaser," gradually vanished as knowledge grew of the number and importance of the conditions that go to the construction and use of a reliable photometer. At last, the Chairman incidentally talked of "dead" gas; and then the Counsel for the County Council began to think of their next engagements. Obviously, to admit one condition as essential to the satisfactory sampling of gas for testing, or the conduct of the test itself, opens a door which, as the French proverb has it, must be either open or shut. Once set it ajar, and in march the Referees, with all the pomp and circumstance of their statutory prescriptions, not one jot or tittle of which has any man condemned as superfluous. Rather is it questionable whether the Referees' system is sufficiently exacting.

Finally, the responsible heads of the three London Gas Companies came, one after another, to enlighten the Committee as to what they hold to be the nature of the Companies' obligation under the illuminating power clauses of the respective Acts, and how this is met. As Gas Companies, they are bound to provide gas of the character prescribed; and they do supply it, under the stipulated conditions. It is a matter of no business interest to a Gas Company whether Parliament requires the supply to be of 14, 16, or 20 candle power. The consumers have to pay accordingly; that is all. Illuminating power, price, and the allowed amount of profit for carrying on the business, are all part of one bargain; and no single element can be disturbed without destroying the balance of the whole. The factitious nature of this particular attempt to upset the gas settlement of London, the utter absence of any real need, or even any popular demand, for the provisions of the Bill, was exposed in scathing language by Mr. Littler; and in the event, this last desperate effort of the Old Guard of Official Photometry, as one hopes it will be—the Photometry which is nowhere without Penalties—was beaten off, with heavy loss. As Mr. Livesey said, in a passage which evidently impressed the Committee, Gas Companies do not require antiquated administrative machinery to keep them up to the mark set by their rivals in trade. The public want cheap gas, and plenty of it; and to offer them instead, at enormous expense, an immaculate record of official gas-testings, pleasingly set out with a list of fines testifying to the vigilance of the Gas Examiners, is a policy of mandarins, not of men of their time.

The Prepayment Meter Part of the London County Council Bill.

As had been arranged, that part of the Bill of the London County Council for the further regulation of the affairs of the Metropolitan Gas Companies which relates to prepayment meter supplies, was taken by Mr. Oldroyd's Committee immediately following the Gaslight and Coke Bill. These proposals are all of a piece with the meddling and muddling suggestions already rejected by the Committee. They proceed on the assumption that the Gas Companies need official regulation at every turn, and are peculiarly obnoxious, inasmuch as they could only obstruct and make more expensive an enterprise which is fraught with incalculable potentialities of benefit to the poorer classes of London householders. It is a new departure in business which the Gas Companies have made, altogether outside their statutory obligations; and the County Council want to be "down upon it," in the worst spirit of bureaucratic fussiness. Nobody can say what further or other modifications in their system of doing business the London or any other Gas Companies may be called upon to make, as time goes on. Ten years ago, the idea that the big London Gas Companies would be selling their product by the pennyworth, would have raised a smile anywhere. Why in the world cannot the London County Council leave it alone? Simply because they wish to be able to pose as champions of the poor gas consumer, whose real needs they know so little of that they wanted to make his gas dearer in the name of photometry. The only sound and wise policy for Parliament and Local Authorities to pursue in regard to the technical and administrative experimental developments of the gas industry, is to give them the fullest liberty and scope in all respects where the major interests of the public are not directly threatened. We see the influence of this new idea in the reluctance manifested by Government to act upon the findings of the Home Office Departmental Committee on Carburetted Water Gas. Liberty is the key to real progress—the liberty of the subject, as Sir James Fitzstephen finely put it. Nobody asks that the gas industry shall be lawless; but the less it is wrapped in the bands of red-tape, the better for its healthy development.

The Gaslight and Coke Company's Bill in Committee.

Mr. Oldroyd's Committee took a day off on Tuesday, at the request of Counsel, and sat again on Wednesday and Thursday to deal with the Gaslight and Coke Company's Bill. This Bill, as our readers have been informed, is for further capital; the amount asked for being £2,500,000, to be raised as 3 per cent. debenture stock. The Bill also seeks to regularize certain transactions of the Company in land; but this is incidental. Practically, it is a Money Bill pure and simple; and is in this respect a *replica* of the Bill which the House of Lords threw out last session. This identity of object was made a virtue of by the promoters, as indicating that they only ask for those additional capital powers which are indispensable to the future existence of the undertaking. The Company demand from Parliament that which has never been denied; and they engage to raise the money in the cheapest possible way. The opposition to the Bill, on the part of the Corporation of London and the London County Council, backed up by many Metropolitan Local Authorities, is based upon the contentions that the sum asked for is excessive, and that the Company ought to have made an effort to meet the recommendations of the Powers of Charge Committee. The opponents did not offer evidence, on the ground that there is nothing fresh in the Bill to differentiate the promoters' case from that which failed to obtain the approval of Parliament last session. To the Company's plea of urgent need of capital, the retort is made that having been away from Parliament, in this regard, since the session of 1876, the petitioners have only themselves to blame if they are driven into a corner. With regard to the amount of additional capital demanded, the opposition say that if they obtained it the Company could keep away from Parliament for another fifteen years, which would be against public policy and specifically counter to the recommendation of Sir James Rankin's Committee which suggests that Gas Companies ought to come before Parliament every five years. To the question why the Bill takes no notice of the findings of the Powers of Charge Committee, the Company's answer is that these relate to matters that do not arise on a question of a fresh issue of debenture capital. To this, the opposition reply that capital is capital, by whatever name it is called; and they do not mean to let the mere words "debenture stock" excuse the Company for what they describe as contemptuous treatment of the result of the labours of the Powers of Charge Committee. There, for the present, the matter rests; for after two days' hearing, and a prolonged consideration in the cleared room, the Committee announced that they would give their decision on the preamble to-morrow.

Concerning an Export Duty on Coal.

In another column we give the views of a correspondent on the question mooted in an "Editorial Note" on the 24th ult. as to whether an export duty on British coal could now be justified on economical grounds. He replies to the question in the negative; and the answer shall go without contradiction from us. We merely repeated a question that cropped up elsewhere; but it may be confessed that we were not oblivious of the particular case of gas coal, the prices of which had been reported to have hardened in consequence of heavy foreign purchases. Our correspondent, if he has a fault, has that of treating the whole question on generalities, without going sufficiently into detail proofs. Supposing that the obligation to pay a five-shilling duty on British coal were to keep a possible foreign buyer out of the British market just when prices were trembling in the balance, would not the coalowner come to easier terms with the home purchaser? It is a little difficult to understand, on the general principles of the political economy of the schools, why the price of such a commodity as gas coal should double itself within a couple of years. Was it too cheap in 1897, or is it too dear to-day? It is one of the unsatisfactory features of economical science that it does

not help the expert in its principles to make better bargains than the ignorant and foolish. Like the science of meteorology, which is all observation and statistics, it does not enable its votaries to foretell much within its own purview. This is the main reason why political economy is popularly regarded as chiefly for the use of schools. And when anyone speaks of the "laws of political economy," would it not be very much better to call them the laws of Political Economists?

There has been far too free a use of the word "law," when all that is meant is a probable deduction from more or less accurately observed and well understood data, reposing on faith in some individual. Dr. Poynting, in his address to the Mathematical and Physical Section of the British Association last year, confessed that most of the so-called physical laws of his acquaintance—including that of gravitation, instanced by our correspondent—are merely "brief descriptions of observed similarities." He wished to get rid of the term altogether. It can never be forgotten that the so-called "laws" of the Cobdenites were held by them to militate against the acceptability of the Factory Acts; and that so strong an Economist as the late Duke of Argyll drew the line at labour, in respect of the sanctification of the "law" of the "higgling of the "market" as determining value. Suppose this country possessed one vein of coal—a natural deposit, of altogether unique and superlative value for some particular purpose—should we be justified in retaining it for our own uses, or should we let the Frenchman have it for a higher bid of sixpence per ton? We may be wrong; but we entertain the suspicion that scholastic political economy has no answer for this question. If there is an answer in the writings of the Economists, it would be well to know it. Meanwhile, it is at least arguable that the only unmistakeable general "law" of economics is the same unique law that Clerk-Maxwell recognized in the world of physics—the law that "the greater of two forces controls the less." It is in the discernment of the forces that the difficulty lies.

The Coal and Iron Markets.

THE announcement that the coalowners have decided to demand an all-round rise of 5s. per ton on their contracts with the Railway Companies has caused some considerable stir, not only in the commercial world, but among the public generally; far more so indeed than the knowledge that a similar, and even greater, increase is being obtained from the Gas Companies, who, as a matter of fact, are in the aggregate slightly bigger consumers of coal than the railways of the kingdom. This more noticeable flutter is probably due to the increase being announced somewhat in the form of an ultimatum, and in no small measure to the fact that—owing to the greater difficulties in the way of the Railway Companies shifting the burden of increased working expenses on to their customers—the effect upon railway dividends (never a very handsome return upon investments) will, if the coalowners get their way, be more severe than upon those of Gas Companies. Whether the increase demanded—equal to about 50 per cent. over the prices ruling in the contracts now expiring, and which were themselves higher than in previous years—will be acceded to by the Railway Companies remains to be seen; but there is no doubt the Companies will have to submit to a very material advance.

The economic effects of the state of the coal market—and, be it added, the determination of the coalowners to push their advantage to its utmost limits—are now beginning to be widely felt; and signs are not wanting of the approach of a decided reaction in the sister market, that of the iron and steel trades. The first quarter of that market to give evidence of the throttling effect of ruling prices is the shipbuilding trade, the activity in which during the past two or three years (and especially during 1899) was to no small degree instrumental in bringing about the high price of iron and steel. For the past two months, however, fresh orders for ships have been as rare as snow in summer; and, although the yards began the year very full of work, slack times are within measurable distance. Inevitably so; for no Shipping Company, unless driven to do so by necessity, would place orders for vessels while the present prices for material and labour are maintained. There is too much uncertainty in the freight world to induce merchants to embark upon new business with a permanent handicap of 50 per cent. more capital on which to earn profit per ton of shipping. The same consideration will naturally commend itself to the mercantile world (as we have more than once brought to the notice of gas people), and is even more forcible in its reasoning in the case of the former—namely, that the present is just the very worst possible time for the expenditure of capital.

Apart from this growing tendency of high prices to hamper trade and reduce the volume of business, another influence is at work which is likely to bring down the prices of iron and steel to a more reasonable level. We mean the fear of American competition. It has been well known for some time that American iron and steel manufacturers are only waiting for a lull in their home trade, or until they have increased their plant capacity so as to be able to manufacture more than the home market can consume, to make a determined attack upon the English and European markets. A series of articles, written by a correspondent who has recently visited the United States, is now appearing in "The Times" containing many interesting facts concerning the methods of American manufacturers, and their designs upon English trade, to which we shall probably later on refer at greater length. For the present, it is sufficient to note that reports of over-production in the States, and of purchases therefrom by English consumers, have of themselves been sufficient to cause something almost resembling a panic in the iron and steel markets not only here but in Germany, and prices are beginning to crumble.

We are far from imagining that anything like a return to normal prices is near at hand. Manufacturers are too well sold ahead, and stocks are too low—those in warrant stores stood at 299,971 tons on the 1st of this month, as compared with 710,916 tons and 652,837 tons on the 1st of May in each of the last two years—for anything but purely nominal and speculative prices to be affected in the near future. But it is interesting and promising to note the extreme sensitiveness of the market to the threat of American imports. A little competition would be a healthy thing; for it is bad for trade generally, as well as for the direct consumer, for the market to be at the mercy of the manufacturers.

Meantime the exportation of coal goes on apace, though, fortunately, the monthly returns for April do not show the same increase over 1899 that was seen throughout the first three months of the year. Indeed the quantity exported was only 3,448,517 tons, as compared with 3,455,109 tons in April, 1899; but last year the month contained one more working day. However, the quantity shipped for the use of steamers engaged in foreign trade fell from 958,073 tons to 860,084 tons; and it is noticeable that, apart from the exports to Russia, Sweden and Norway, Germany, Holland, and France, the shipments show a marked falling off. That is to say, the more distant markets are being supplied from other sources—probably America; and the trade so lost will be with difficulty recovered. But until the coal trade in Russia, Germany, and France becomes easier, the exports will continue to be greatly in excess of the normal. For the first four months of the year they exceeded the shipments during the same period in 1898 by $2\frac{3}{4}$ million tons; while the money value was more than double. There are worse fates than that of being a coal proprietor in this present year of grace.

Examinations in Gas Manufacture.

WE published last week the questions set at the recent City and Guilds of London Institute Examination in "Gas Manufacture," and also an abstract of a paper on the subject of such examinations read the other day by Mr. S. E. Halliwell at a meeting of the Manchester and District Junior Gas Association. Mr. Halliwell expresses accord with the views advanced in the "JOURNAL" last year, in reference to the Honours paper in the City and Guilds Examination—namely, that it is a physical impossibility for any but a lightning worker and draughtsman to do himself anything approaching justice in the attempt to answer, within the space of a bare three hours, ten questions of the scope and character which mark those set in the higher grade of that examination. Mr. Halliwell also endorses our opinion that there is sufficient work entailed in the answering of those questions to occupy students for twice the time allowed; and he makes, as an alternative proposal to that we put forward—of dividing the examination into two separate papers, dealing with "Manufacture" on one evening, and "Distribution" on another—the useful suggestion that the division might possibly be made into one paper on the

"Engineering" and one on the "Chemistry" side of the science of gas manufacture, with a separate certificate in respect of each section.

We are in no way bound down to the division originally outlined. What we are concerned with is the rendering of the Honours certificate accessible to the student with the requisite knowledge and ability to answer the questions were he given reasonable time to do so, and not merely to prodigies of rapid writing and drawing. We are, therefore, glad to see that—whether or not in consequence of our criticisms we do not know, nor does it matter—a step has been taken this year in the right direction. Whereas, formerly, the examinee was expected to answer all the ten questions in either grade in the space of rather less than three hours (for time is always lost in reading through the paper, getting under weigh, and revising the answers written) the candidate this year was only required to answer eight out of the ten questions set. This, as we have said, is a step in the right direction; but it does not go far enough. Let any of our engineering readers, who have never been through the mill of this examination, take the Honours questions on p. 1238, and attempt to write answers to them in $2\frac{3}{4}$ hours, especially noting how long they require to make presentable and intelligible sketches describing the construction (1) of a regenerative furnace for heating a bed of gas-retorts, (2) of (*a*) a trussed, and (*b*) an untrussed, gasholder crown, and (3) of a gasholder without columns.

Apart from the question of the time allotted to the work of answering the questions, we would venture to make a further suggestion in reference to the examination, as to the nature of the questions set. Those questions range over the whole field of the many processes involved in the production of illuminating gas of standard purity from the coal delivered at the works, and require a thorough theoretical knowledge for their answering. But can it be said that the man who could give correct replies to every question would thereby have proved himself to possess any practical knowledge whatever? We think not. The whole of the Honours paper this year could be answered by a well-crammed student who had never been inside a works, or seen a main or service laid. It is, we know, a difficult matter to gauge a man's practical knowledge by a written, as distinguished from a *viva voce*, examination; but would it not be some test if a question were occasionally set—as such questions are put to candidates for Board of Trade Navigation Certificates—requiring the candidate to explain what course he would pursue at times of difficulty and danger such as occur in the history of every gas undertaking? The fracture of a trunk main, the tilting of a governor bell, a big fire or explosion on the district—without going inside the retort-house it is easy to multiply instances of occasions when the merely book-learned man would be useless. May we not learn a lesson from our present national experiences as to the inefficiency of "Staff College" training only? It would certainly advance the certificates of the City and Guilds Institute along the road to wider acceptance by employers as evidence of usefulness and capacity on the part of the successful candidates, were marks of distinction given to students displaying practical as well as theoretical knowledge.

The Fall in Gas Stocks.

On Friday week the "Financial News" contained a leading article on the subject of the fall in the market price of gas stocks. Their remarks on the subject were well informed, and the advice given—to hold on to this class of investments regardless of all attacks on them—was unexceptionable. The statement of the amount of the depreciation of the prices of gas stocks in some instances cited by our contemporary was very startling. Quite possibly some timid people may be frightened at it, and so contribute, by selling, to the aggravation of a state of things which is not at all alarming to those who know what it all means. Naturally, no well-advised Gas Company will attempt to sell fresh capital until the clouds roll by. The reaction is bound to come. Meanwhile, the public will continue to think that gas is in a very bad way, because coal is dear and the price of gas in very many places will have to be raised accordingly. In London, the fact that the London County Council had chosen this happy moment for worrying the Gas Companies about candle power, doubtless helped to depress the gas-share market. But dear coal is really at the bottom of the trouble, such as it is. Mr. Helps spoke rather sadly on this very subject at the meeting of the Institution of Gas Engineers the previous week; and we may notice that an electrical print quotes his vaticinations with unholy joy. There is, however, no comfort in dear coal for electricians, as many electric lighting undertakings learnt to their cost last winter. When an electrician gets hold of a piece of coal, it goes off in energy and smoke. He has no residuals to bless himself with. The gas engineer, as everybody knows, has other products of carbonized coal to sell besides gas; and he wastes practically nothing. The coalowner may pinch him for a year or two; but things in due course work themselves down to a natural level. It is no bad thing, on the whole, that the prices of gas stocks should have been smartly shaken of late. We have long argued that they were overvalued, for purely industrial stocks, even with the advantage of statutory protection. It will not hurt the gas industry in the long run if stocks can be bought to pay 5 or even 6 per cent. This is only to return to the conditions ruling fifteen years ago; and the times were not then thought bad.

Illicit Commissions Exposed.

The canker of illicit commissions has been laid bare during the last few days in the course of two remarkable and important law cases. The first was an action brought in the Queen's Bench Division to recover the amount of secret commissions alleged to have been paid by the defendant to the plaintiffs' servants, and for the return of alleged overcharges for goods sold. The proceedings are a disheartening disclosure of the way in which a certain class of City firms do business with their customers' "buyers." The plaintiffs were "sundrymen;" and they dealt, among other goods, in tobacconists' wares. It was alleged that the defendants, who supplied plaintiffs with this class of goods, systematically paid commissions to the buyers, as part of their trade expenses. The facts were not disputed; but it was pleaded that there was no conspiracy to defraud the purchasers. "The way in which the presents began to be "given was that witness (the firm) noticed that the business "with the plaintiffs was increasing; and it was suggested that "it would be as well to be on good terms with the buyers. "Witness had no fraudulent intention in making these pre-"sents; and the prices did not vary in consequence. These "presents came out of their profits. They were not pro-"portionate to the business done." The charges made to the plaintiffs had not been increased thereby. One of the ex-buyers, now in independent business, testified to having received presents from the defendants, but denied that they had influenced him in any way. Others said very much the same. On the evidence, the Jury found that there was no fraudulent conspiracy to raise prices; that the prices were not excessive; but that the unknown commissions did have some effect on the minds of the buyers, being the plaintiffs' agents, in inducing them to give the orders and pay the prices stipulated for. Damages—one farthing! The conclusion of the findings was evidently influenced by the particular circumstances, with which we are not here concerned. The important thing to notice is that, for the first time, the legal issue was raised as to the nature of customary gifts—almost "tips"—given out of the merchant's own pocket to the agents of his customer, with a view to make things pleasant and easy all round. Still, the transactions were of a fraudulent character, although no specific harm was alleged. The commission system was seen here at its best, so to speak, although the defendant could not deny that he had often given what were called Christmas boxes at Midsummer. The somewhat confused verdict of the Jury testifies, as the Judge remarked, to the difficulty of dealing with cases of the kind. As there may be an appeal, it is better not to comment further on the findings.

The other case was the criminal prosecution of F. F. Norris, late Secretary and Cashier of Frank Wright's Prepayment Gas-Meter Corporation, Limited, on a charge of misappropriating money and making false entries in the books. He denied that he had used the money for his own purposes, and asserted that it had been expended in paying secret commissions in connection with the business of the Company. The Directors of the Company stated that they never gave any authority for the payment of secret commissions and had no knowledge whatever that such payments were made. In view of the possibilities of this case, we arranged for a special report of it to be taken; but, in the circumstances, we shall not give publicity to all that was said by the prisoner to exculpate himself. He was found guilty, and sentenced to five years' penal servitude. It is a sad record; and who shall say how far the prospect

of obtaining immunity from detection under the pretence of giving commissions tempted this wretched man to his fall? That is one of the very worst incidents of the whole rotten system. It is impossible to tell who is or is not honest, for money cannot be traced. If the Lord Chief Justice's Bill were law, the documents in such a case would be impounded with a view to further proceedings; and this consideration ought to act betimes as a deterrent to those who have been brought up in, or have fallen in with, the notion that tips, treats, and commissions "to ease the way of trade" are not reprehensible.

Housing the Working Classes of Towns.

THE Government Bill for the Better Housing of the Working Classes in towns was discussed last Thursday in the House of Commons, and unfortunately not advanced. Most of the adverse criticism on the measure is directed to what it does not contain—a very cheap and handy form of fault-finding. It is so easy to say of any proposal for helping a movement of reform, that it is good so far as it goes, but that it does not go far enough. "Who goes softly, "goes safely," says the Italian proverb; and it is the greatest fault a Legislature can commit to pass laws ahead of public opinion, which is the only motive power that can be relied upon to carry them out. At this time, when the perfervid partisans of Municipalism are clamouring for all sorts of "trades" to be entrusted to Local Authorities, it is more than a little disconcerting to such thick-and-thin advocates to point out that in the matter of housing, Municipalities have failed to realize their powers, and have neglected their duty. It is very disappointing to find so-called Progressive Local Authorities exhausting their credit, and occupying their time, with a toy like electric lighting, when the same money might obliterate the plague-centres from their midst. The Government Bill proposes to enable Local Authorities to go outside their own areas to purchase land on which to erect workmen's dwellings. This is a step, and a considerable one, in a progress that must go by steps, if at all. The plain fact is that Urban Authorities generally have never taken up the cause of improved housing in a serious manner. Now and again some appalling statements about the number of people living in one room, and so forth, have been made in Parliament and upon platforms these many years past; and measures have been passed to enable Local Authorities to deal with the matter of over-crowding in various ways. But these powers have not been exercised. Any excuse has served to extenuate the neglect—difficulty of ascertaining the owners, difficulty of proving the existence of insanitary provisions, excessive cost of dealing with "areas." The real truth is that in hardly a single local government area in the country is the Medical Officer of Health properly supported, in the first place, or his recommendations wisely acted upon, in the second. Where Local Authorities have taken steps, it has usually resulted in the erection of huge barrack blocks, as to which, as Mr. Chaplin says, who knows how soon these structures will be condemned, even as the huge poor law schools of the last generation? An interesting point made by Mr. Chaplin was that the question of not requiring the money spent on land for building purposes to be repaid would be seriously considered by the Government. Another curious element in Thursday's debate was the readiness of members of Parliament to throw to the winds all the dictates of political economy when these conflicted with their other politics. The good old "law of supply and "demand" fared particularly badly on this occasion. Mr. Steadman advocated, with approval, a fair-rent court, which should dictate to landlords the amount of rent they are to take in cases where poor people are ready to bid against each other for accommodation. Where was the honoured shade of Cobden all this time?

A Lecture on "Artificial Lighting" was delivered, last Saturday week, before the Birmingham Association of Mechanical Engineers. The speaker, Mr. A. E. Edwards, dealt with several means of lighting, including the oil lamp, gas, electric, incandescent, acetylene, and arc lighting, and gave some interesting figures as to the lights obtainable by them. He spoke of the desirability of having workshops well lighted and painted with suitable colours; saying that if a room was coloured white, the lights in the room would give nearly 50 per cent. more illumination than they would do if the room were black. With reference to cost, the lecturer said that for small rooms incandescent gas lighting was at the present time the least expensive.

INSTITUTION OF GAS ENGINEERS.

PROCEEDINGS AT THE GENERAL MEETING,

HELD AT THE

INSTITUTION OF CIVIL ENGINEERS,

MAY 1ST AND 2ND, 1900.

Mr. J. W. HELPS, M.Inst.C.E., of Croydon, President.

PAPERS READ.

[*Continued from p.* 1210.]

INCLINED RETORTS AT BANKSIDE.

By C. C. CARPENTER, of London.

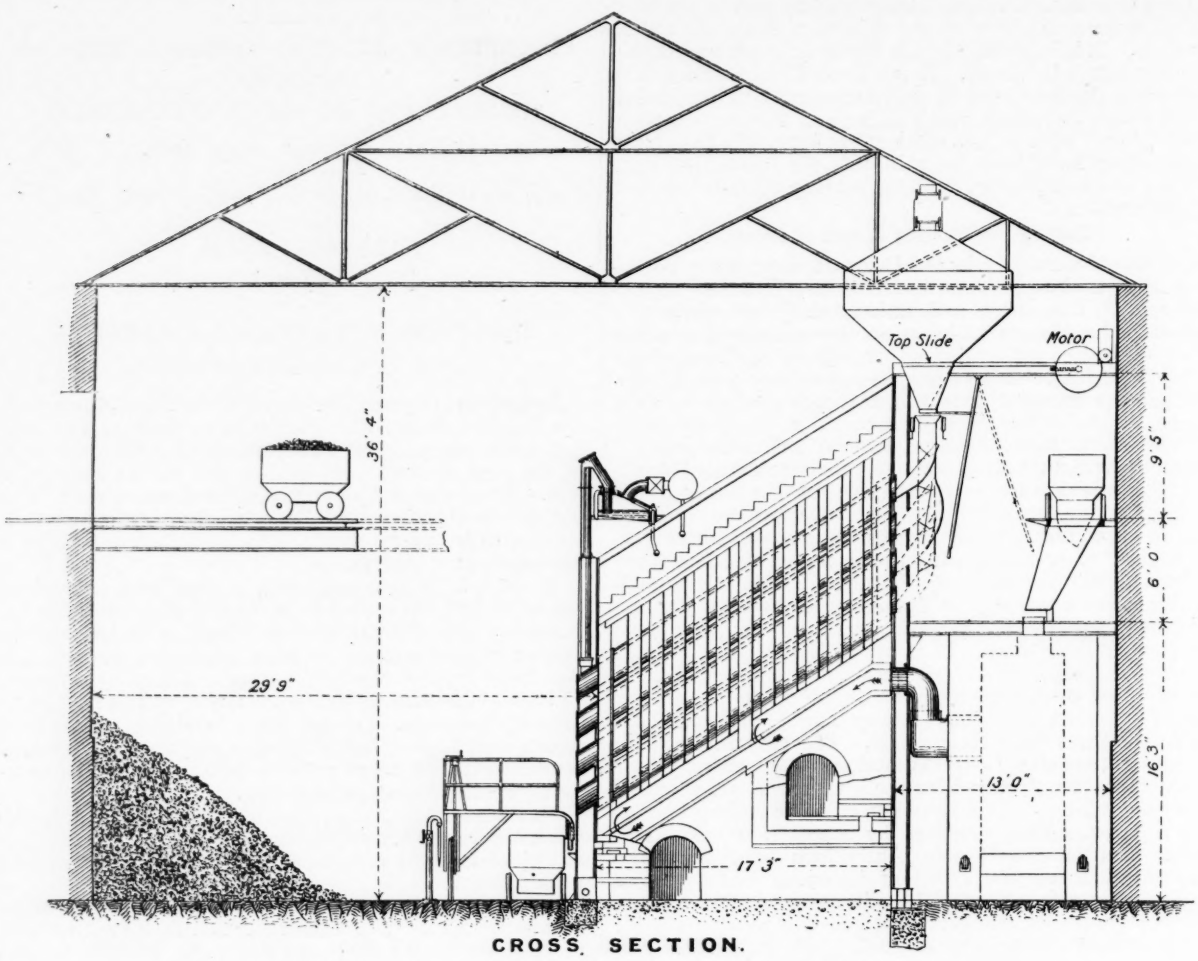
Bankside is the smallest works of the South Metropolitan Gas Company; their output being from 1¾ to 2 million cubic feet per day. They are worked for six months of the year at their full capacity, and for six months at half. Their size and absence of disturbance from "lighting up" or "letting down," render them extremely suitable as experimental works, for which purpose they have been considerably used.

In 1896, it became necessary to consider in what form the retort-benches should be renewed during the following summer. The alternatives were, of course, stoking machinery or inclined retorts. Several installations of the former had been applied at various of the Company's works; and their mechanical and gas-making efficiencies were thoroughly known. On the other hand, the only sloping retorts were in practical working in conjunction with horizontal ones; and it was possible to differentiate their efficiency during testing periods only.

Somewhere about this time, Mr. James Husband, who (with Mr. Frank Morris) made a good deal of the English history of inclined retorts at the Brentford and Southall works, gave the author several opportunities of inspecting the plant both in its early and late stages, and in course of its construction. The author takes this opportunity of expressing to both these gentlemen his thanks for the kindness and courtesy with which their works and working were invariably opened to his investigation. He saw various kinds of coal operated, large and small, dry and damp; and in the end he came to the conclusion that he could equally make inclined retorts a success, and therefore recommended their adoption at Bankside.

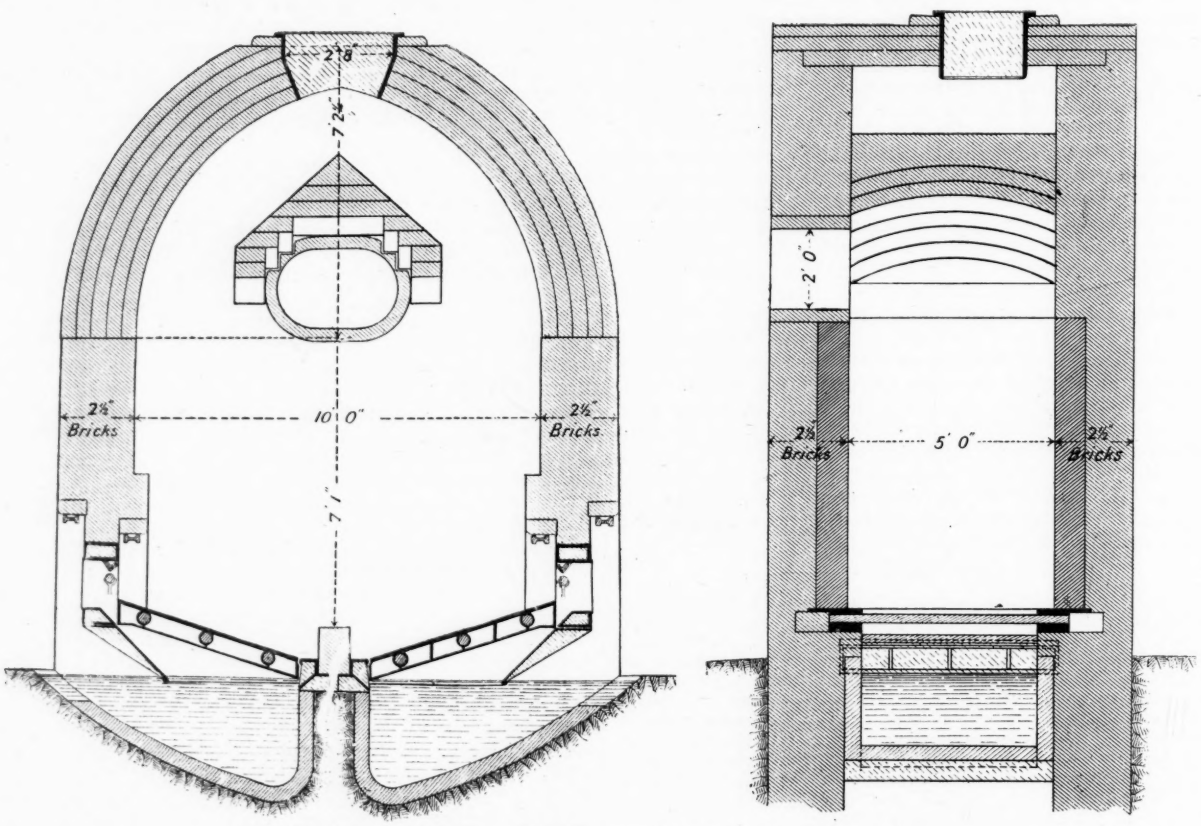
The retort-house was an old one built by the Phœnix Company in 1840. At some time or other in its history, the retort-benches had expanded horizontally and laterally and thrust the walls out of the upright, distorting to some extent the roof principles also. In substituting inclined for horizontal retorts, therefore, one of two courses was open, either to pull down the house to the ground-level and rebuild it with a new roof, or to design the retorts to fit the existing building as it stood. The latter course was adopted, and explains certain characteristics of the arrangement.

The general outlines are shown on pp. 1276-77; and in explaining these, the author proposes to state briefly the reasons for the adoption of the various details. The setting is of eight retorts, four high in two vertical rows. It was not possible to make the setting a complete "Imperial" one, owing to lack of necessary head-room. The author, therefore, had to be content with four superposed retorts, instead of five. The retorts are 20 feet long, and provided with one 6-inch ascension pipe at one (the lower) end. The late Mr. John Methven for many years worked his horizontal retorts at Nine Elms under similar conditions; while his make and quantity of gas per ton were among the highest in his Company. These facts were considered by the author sufficient justification for the dimensions he adopted. Having determined the length, it became necessary to consider the shape and size of the retorts. In many cases, these have been made taper to facilitate discharging; 4 inches in 20 feet being not an uncommon amount. This is, however, but one in sixty, or one-fifth inch to the foot; and it appeared to the author that, having regard to the distortion and cracking of retorts by use, such a variation from the parallel could not be of much moment either way. On the other hand, several

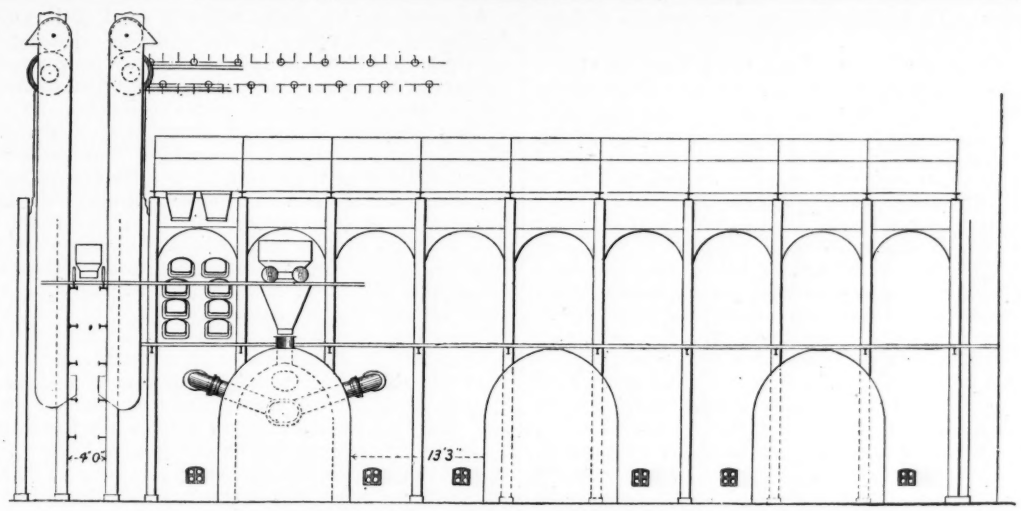


CROSS SECTION.

INCLINED RETORT-HOUSE—SOUTH METROPOLITAN (BANKSIDE) GAS-WORKS.



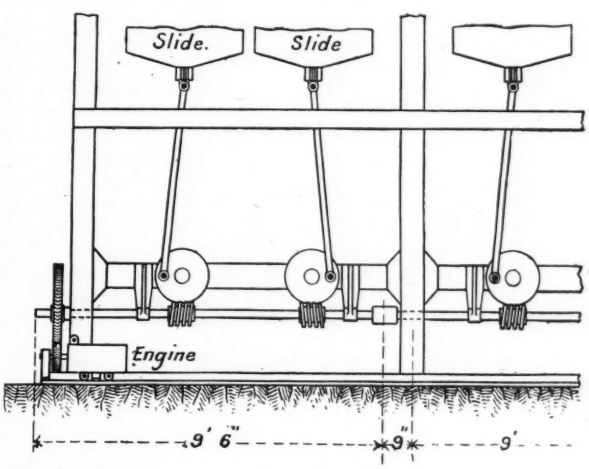
PRODUCER FOR THREE BENCHES OF EIGHT INCLINED RETORTS.



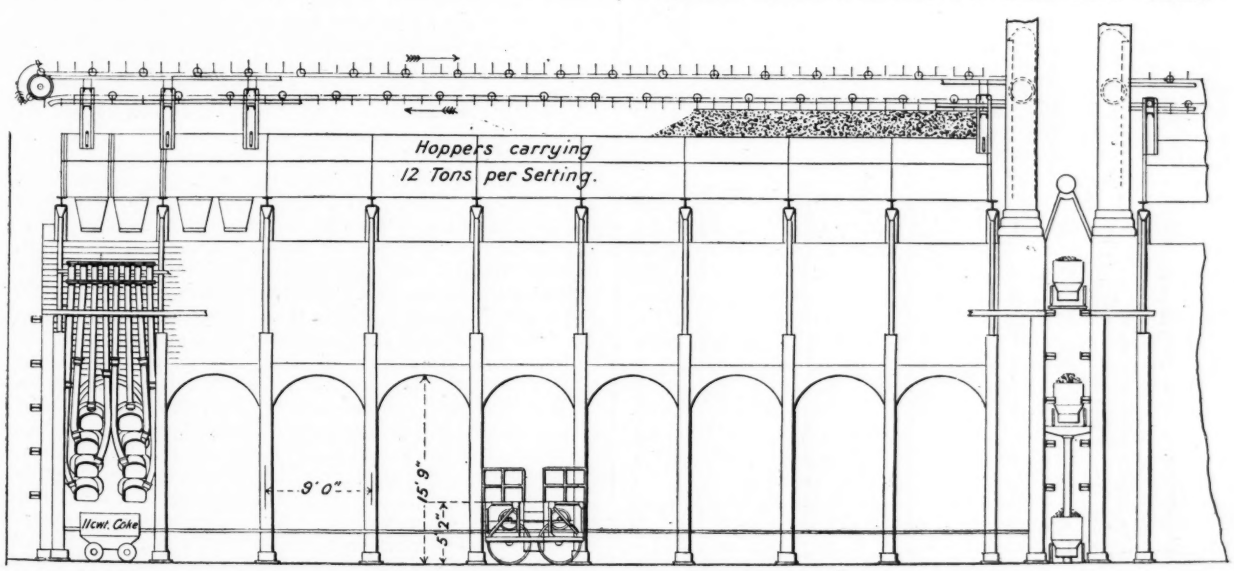
ELEVATION CHARGING SIDE

disturbing conditions are introduced by the employment of taper retorts.

In the first place, it cannot be so easy to make a true taper retort as a true parallel one; and the latter can be made a better job of in setting. But the more important condition is that a set of taper charges in the retorts of the setting should mean a set of "taper" heats—surely a retrograde step in the proper carbonizing of coals, even if such a requirement was easy of attainment, which, compared with uniformity, it is not. Parallel retorts were therefore decided upon; and the author has no reason to regret his choice. The retorts are a modified Ω shape; the minimum of radius being given to the lower corners. The sides are vertical, in order that the charge, as it is carbonized, may freely rise, and not jamb against the crown in discharging. As it would (nominally) be unnecessary to use stoking tools, there was no occasion to leave more room above the charge than was required for the passage of the evolved gas. The space therefore could be reduced to a minimum, and the time of "rest" for the gas in the retort



GENERAL ARRANGEMENT OF TOP-SLIDE GEAR—PLAN.



ELEVATION. DISCHARGING SIDE

largely lessened. The retorts are 24 inches wide, sides 7 inches high, rise of crown 6 inches. They are set at an angle of 32°.

The setting itself is completely divided, by a middle wall, into two complete independent settings. The credit for this arrangement belongs, the author believes, to Messrs. Morris and Husband, and is a ready means of adjusting the heat requirements either of the upper or lower portions. At Brentford this was attained by leaving an opening in the middle wall, which could be increased or reduced at will by the use of tiles or bricks, thus admitting more or less heat to the upper end, as might be required. The middle wall in the Bankside settings is solid—no arrangement having been made, or found necessary, for regulation of the heat. The inclined gas-flue from the producer returns upwards again from its lowermost point, and is provided with two openings which supply gas to the lower end of each gas-flue in which the nostrils are formed. These are all of one size, as are also the ports supplying them with secondary air. All the regulation, therefore, that is possible is obtained by the four exit-dampers at each corner of the setting. It is

found in practice that with such an arrangement of flues none other is required.

The secondary air-heating flues are formed in steps, each of which carries one of the cross-walls. These cross-walls are made of 9-inch bricks laid to the retort angle and to 15-inch centres. For this arrangement of air-heating flues, the author is indebted to the ingenuity of Mr. John Brown, his foreman retort-setter, who suggested it as a more stable foundation for the retorts than the sloping flues originally contemplated. There are two main flues and two shafts. The former are a convenient means of reducing the quantity of brickwork below the floor-line. The dampers and secondary air-shutters are conveniently arranged for access and cleaning. Each producer supplies gas to three settings—*i.e.*, 48 mouthpieces. The producers occupy the space under the charging stage, which forms a very convenient position. They are quite independent of the retort-benches, to which they supply their gas by means of 18-inch cast-iron pipes. Butterfly valves are provided to check the draught when the doors are open for clinkering. The charging-doors are 19 ft. 6 in. above the ground working floor. The take-off pipe can therefore be fixed a considerable distance below the upper part of the producer; and this space forms a hopper for the cold fuel which automatically falls, and keeps the fuel-bed at one level between the periods of charging. No cold air is admitted during this operation. All the coke required for the producer has to be raised from the ground floor to the producer mouth-level. To this disadvantage, there are several sets-off, apart from the fact that, with the house in question, owing to the limited head-room, no other arrangement was possible. The weight of coal carbonized is ten times that of the fuel put into the producer. To charge the latter by gravitation, would necessitate lifting the whole of the raw material a sufficiently greater height to allow one-tenth of it, in the form of coke, to fall into the producer. The author uses a hydraulic waggon-lift as a substitute. The working costs are set out in the table appearing at the end of this paper.

The coal-charging shoots are arranged after the Brentford pattern—*i.e.*, the measuring chamber is fixed at such a height above the top retort as to give sufficient fall with the worst description of coal used. With "livelier" coals, and for the lower retorts, a flap-check is provided in each shoot, actuated by a lever fixed to either end of a spindle on which it is mounted, working in a quadrant, by which it may be set at will to afford any "check" or "baffle" required. With any kind of coal, it is easy to lay a perfectly level charge in any retort by these means. In order that the flow of the coal stream from the measuring chamber to the retort should be regular and uniform, the width of the slide or door-opening and of the shoot were all kept the full width of the retort—namely, 24 inches. Only the lower door of the measuring chamber is operated by hand, and therefore under control of the stoker. The upper doors are attached, by means of a long rod, to a crank-pin fixed to give the required stroke on a worm-wheel, which is placed opposite. The worm-wheels are in right and left handed pairs, driven off corresponding worms keyed upon a longitudinal shaft running the length of the bench. As the worms are in right and left handed pairs, they balance one another, and produce no end thrust, so that the entire set of doors is easily operated simultaneously by one of Messrs. West and Co.'s smallest size motors. As a complete revolution of the worm-wheel must be made at every operation, each measuring chamber *must* always be entirely filled for each charge.

The coal is brought into the retort-house by an overhead railway, shot into the breaker, elevated, and conveyed to the overhead continuous hoppers in the usual way. The railway, by means of a turntable, is in connection with lines running at right angles, along which the coke-waggons run which feed the producers. These runs also serve the purpose of affording the "charging" stokers what access is required by the two upper rows of retorts; the two lower ones being reached, of course, from the stage. At the discharging end, the bottom row of mouthpieces is worked entirely from the ground, and the three upper ones from a light trolley, the wheels of which run on metals kept clear of the coke-heaps made during each "draw." The expense of a second stage is thus obviated. The coke is quenched and thrown back against the retort-house wall, where it forms a store, from which it is loaded into vans or carts as required.

As only one hydraulic main is used, it is made with double the usual area at the liquor-level. The tar is taken off from the bottom in the manner now usual. The hydraulic mains are made in single lengths, carried, as are the foul mains, from the diagonal H-iron tie.

The foregoing is a brief description of the Bankside plant. Some details of its working must now be given. The first three settings were put to work in February, 1898; the remainder of the nine benches (forming half the retort-house), two or three months later. At this time, one-half of the retorts in use still consisted of the old horizontal pattern. With the new inclined retorts, high and regular heats were obtained; and charges averaging 6½ to 7 cwt. were worked off with ease. The make of gas per ton fell off, however, instead of gaining, as is generally the case when a new set of retorts is put into action. It was assumed that the fault lay with the old section of horizontals, the renewal of which was considerably overdue. The drawing and charging of the inclined retorts promised well; and therefore the material for the second section was ordered, so as to complete the house. To proceed with this work, the horizontal retorts were put out of action, and the work of demolition proceeded with. But the make of gas per ton of coal was generally less, instead of better. Week by week, month by month, went by, and the search was unremitting of those concerned for the missing gas. One Sunday was given up to testing the station-meter. Then another for the soundness of the various valves. Then the bye-pass was taken out and sealed up. Then the washing and purifying plant put under pressure, and tested for soundness with a blower and meter. Observations were made to see if the make of gas fell when one or the other washing or purifying vessels was shut off for changing; and the mains and connections were also cleared and examined. The hydraulic seal was varied, and the retort-house vacuum altered; but without improvement. All this time coal had been drawn as usual from the Durham deliveries, and week by week the coal stock was anxiously taken. Sometimes the make of gas per ton would be a little over 9000 cubic feet, sometimes below. Meanwhile, earnest and continued attention was given to the retort-house. The pressure in the bottom mouthpieces and in the top ones, in the ascension-pipes, the arch-pipes, the dip-pipes, and the hydraulic mains was tested in all ways, but without throwing light on the cause of the trouble. Two observations stood out, however, beyond the others. One was that the retorts scurfed so rapidly that they had to stand off at no greater interval than once in three weeks. The other was that the irregularities in the thickness of the charges could not be laid at the door of any particular men. With the best of men sometimes matters went all right, and at others all wrong.

About this time, too, the suggestion was made that the heats were so good that the charges were slipping down in consequence. Since coal would rest in a cold retort, even if it slipped in a very hot one, it was argued that improvement would be attained by working nearer to that limit. It was thought, too, that irregularly shutting the doors produced the same effect; for charges which were watched and noted as being perfectly level were, when slacked out for drawing, found to completely fill the bottom of the retort. The appearance of charges was then noted by leaving the upper lid unclosed; and though perfectly level at first, yet in a period varying from ten seconds to a minute or two it was found that the coal had slipped down until it had risen to the crown of the retort. Here, then, was the clue to the mystery—that no matter how carefully the coal was laid, in the process of burning off it slid down to the lower extremity of the retort. The next step forward was to trace this effect to certain kinds of coal, which were diverted from Bankside, and a selection made of those varieties which gave no trouble in this respect. The result was most marked. The make of gas rose to about 10,300 cubic feet per ton, and has remained at about this figure since. For the purpose of this paper, trials were made with four of the principal descriptions of coal wrought in the Durham district and used by the South Metropolitan Gas Company. Each kind was used for two or three days prior to commencing the trial, so that all the conditions might previously become normal.

Each experiment consisted in carbonizing about 1000 tons of coal. The above coals produce, in average working, with horizontal retorts, from 10,200 to 10,600 cubic feet per ton. The whole of the difference in working is

that when carbonizing "A" quality the charges remain where placed. With "B," "C," and "D," they slipped while being worked off. The weight of charge and the heats worked were identical within practical limits.

Kind of Coal.	Gas per Ton at 60° and 30".	Coke Sold.
	Cubic Feet.	Cwt. per Ton.
A	10,392	10·4
B	8,736	10·9
C	9,093	11·0
D	9,420	10·6

Only one defect made itself apparent in the plant. It was important, and deserves notice. The coal-conveyor above the continuous hopper, as originally arranged, worked between two angle-iron guides placed about 10 inches apart, and running the entire length of the hoppers. The coal, as conveyed, fell through the space between, making its own angle, and as it piled up formed the continually extending bed along which the successive portions were scraped. If the quality or condition of the coal supplied to this conveyor varied during the process of filling the hopper, it would be arranged therein in an inclined stratified condition; the extent of each stratum being the angle of repose of the coal in the hopper, or only a few feet horizontally. So that if there were four changes of coal during the operation of filling the hopper, the first portion would have one quality, the second another, the third another, and so on. The retorts are charged in horizontal order, and under the above conditions four charges of coal might be used in operating but one row; and the shoot baffles, after having once set, would require two or three alterations and adjustments in travelling from end to end. This proved in practice a considerable disadvantage; but it was easily overcome by closing the bottom of the coal-conveyor and making a series of openings provided with adjustable slides. These regulate the amount of coal, and distribute it pretty evenly in *horizontal* strata in the hopper, so that whatever adjustment of charging-shoot is needed, it is maintained row by row.

The cost of working the bench of 144 retorts per twenty-four hours is as follows, working six-hour charges of 6 cwt. = 73 tons per day:—

		s.	d.	Per Ton. Pence.
Chargers	8 men at	7	1	11·19
Drawers	8 ,,	7	1	
Coke trimmers and quenchers	8 ,,	6	0	
Filling furnaces	4 ,,	6	0	
Clinkering	2 ,,	7	1	3·63
Emptying pans and wheeling out	2 ,,	7	1	
Screening and picking	2 ,,	7	1	0·98
Coal breaker and elevator	2 ,,	6	0	0·83
Mains and pipes	1 man at	6	2	0·43

The entire installation cost, from the floor-line, slightly under £14,400, or £100 per 20-foot retort.

Analyses of the producer gases are appended.

Percentage of Volume.

Test.	CO.	C_2.	H.
1	26·0	6·0	8·4
2	26·4	4·0	8·0
3	25·2	6·0	7·8
4	25·6	4·8	7·4
5	26·4	4·2	8·4
6	25·6	5·0	8·6
7	25·2	5·6	7·4
Average	25·8	5·1	8·0

Discussion.

Mr. W. R. HERRING (Edinburgh) said one felt at considerable disadvantage in discussing a paper of this kind in the absence of the author, especially as he intended to criticize it somewhat severely. His first impression was that it was a very elementary treatise on a subject which was now fast becoming old. It certainly traversed a good deal of ancient history. The author had accomplished in 1898 what had been done a great many years before; and, in his opinion, he had adopted a model which certainly did not possess all the advantages which were to be found in the system as adopted in some parts of the country. With regard to the general outline of the settings—which consisted of eights, in four tiers—this was a matter he should have particularly liked to discuss with the author. It was an open question whether they could not go four or five tiers high; but the point he wished particularly to get from him was why he did not adopt settings of nines. They must, of necessity, be cheaper per retort than settings of sixes; and if there were four rows, one had a setting of twelve instead of eight. Nine retorts was the common setting on the Continent; and he never put up anything else himself. Of course, if badly constructed, the central one would soon be burnt out; but it was easy to build them in such a way as to get less heat in the central retort than in the other part of the setting. The 20-feet length was all right; and a 6-inch ascension-pipe at the lower end was the general practice. He did not know of any setting that had two ascension-pipes; and he questioned whether, if there were two in a horizontal setting, they were ever both working together. It was almost physically impossible that they could. One could not have the same seal, and exactly the same pull, on the two opposite sides of the bench. Whether 6 inches was the proper size of pipe, was another question. He thought that a larger one might be better. An important question was raised as to the shape and size of the retorts. He had had considerable experience with most shaped retorts for inclined settings. Originally, he had parallel ones. He then substituted taper retorts, and was glad to agree with Mr. Carpenter that the advantage of the taper was not what appeared on the face of it. There was far more importance in the question as to the design of the cross-section. Mr. Carpenter had hit the mark very nearly in adopting vertical sides, and carrying them high enough to prevent the coke jamming in the crown; but if they were increased a little in the central line on the top of the charge, to 1 inch, he would find a considerable advantage. It was one of the secrets of success to make sure that the cross-section was carried through to the mouthpiece. Six inches might be a sufficient vertical line for the cross-section of a sloping retort; but when it was cut at an angle of 32°, one wanted $7\frac{1}{2}$ inches in the vertical line, or to extend the line and continue the parallel side to the outside. Very often the charges stuck in the mouth of the iron mouthpiece. He could not agree that there was any difficulty about making taper retorts. There were two machines in existence by which taper retorts were made beautifully by an expanding die; so that there was no difficulty in getting them if they were of any advantage. With regard to the construction of the setting, credit had been given to Messrs. Morris and Husband for dividing it up by a central solid partition wall; but he really did not think the author could be serious in writing that, for such settings had been constructed almost from all time. Mr. Carpenter said he was indebted for the arrangement of the air-heating flues to Mr. Brown; and he was not sure whether he did not infer also for the foundation or floor of the setting being constructed of brickwork laid on the horizontal line, while some of the earlier installations might have been constructed on sloping walls. There were none certainly within the last seven or eight years where the brickwork had been so built. Entirely horizontal work should be laid as far as possible stepped back, and filled in to form the angle with splay bricks. There was an important question, again, with regard to the producer. From the diagram, he could scarcely see how the construction of these three beehive producers could be cheaper than, if as cheap as, the ordinary construction with the necessary number of independent furnaces beneath the sloping tiers of retorts. Although he got two flues in, in order to save some bricks, he still had an immense amount of solid brickwork beneath the upper ends of the sloping sides. In addition to this, he had a huge construction beneath the charging-stage, which must help to warm it up for the men, and make it uncomfortable. The producers must be strongly strapped with iron. There was one producer to three settings, and two furnace-doors to clinker. He should be very glad to have some exact figures as to the cost of working an outsider producer, as against an inside one. Again, the outside producer necessitated the lifting of the coke. A producer 10 feet deep would not be sufficient to generate gas for three or four settings; and he did not see what gain there could be with the arrangement. The charging-shoot was all ancient history; and he did not think Mr. Carpenter had the best one even now. Another important question arose, as to the method shown on the diagram by which the coal was brought from the storage-hopper into the measuring-chamber. It was worked by a series of worms and worm-wheels; and they all knew that, from a mechanical point of view, worms and worm-wheels

cost more, piece for piece, to manufacture than a silver watch. Why all this unnecessary mechanism had been introduced to move the slides—which were easily moved by a lever from the base—he could not conceive. It was introducing unnecessary complications in a process which was intended to do away with mechanical complication. Mr. Carpenter did not appear to connect the upper charging-door of the chamber with the lower one, as was common, so that on closing one the other was opened. He should like to have heard what Mr. Carpenter's object was in adopting such a mechanical device, when the work could easily have been done by a mere stroke of the lever cutting off the lower chamber from the charging shoot. The question of slip, Mr. Carpenter appeared to have overcome in the same way as everybody else. If he found some of the coal slip, he mixed it with coal which did not; but, at any rate, Mr. Carpenter appeared to have become a convert to the system.

Mr. F. D. Marshall (Copenhagen) also regretted that Mr. Carpenter was not present. He agreed that there was no advantage in using taper retorts. With regard to the cross-wall, it was always a debatable point why one should have a cross-wall in the centre of a setting. He was now putting up a large setting of 17-feet retorts without a cross-wall. Mr. Carpenter preferred putting his main flue inside the setting; but after many years of experience he (Mr. Marshall) had come to the conclusion that the outside was the place for the flue. If the flue gave way, it let down the whole superstructure; and he did not see any saving in expense. If the flue were outside, it could be easily got at; and the stability of the structure as a whole was greatly enhanced. In regard to the slipping of the coal, it had been a serious matter; and after numbers of experiments, he found it was due chiefly to using fine coal put in in a dusty condition. The gas making commenced immediately the coal touched the heated surface; and the gas, being unable to push itself through this compact mass, raised up small volcanoes or little hills. Thus one got a series of truncated cones over the whole surface, and there was a tendency to set the complete mass in motion. They got over this difficulty by putting in the coal in a less fine condition—not breaking it so small. If they had to depend on one description of coal for inclined retorts, they would be in a bad case, because the price would very soon be raised. He should be glad if Mr. Herring, or someone else, would take up the question of the cost of making gas by inclined retorts as compared with other methods. Why the author put in eight retorts instead of making three tiers and having nine, he did not quite understand. As a whole, there was little originality; and he thought they were really making a retrograde movement in studying the diagrams.

Mr. R. Brown (Cambridge) said that with regard to taper retorts, his own experience was there was nothing in them; one could do just as well with parallel ones. It was said the coke was got out better. That might be so at the start; but after the retorts were a bit worn, the coke required just as much tickling to get out as with the others. Mr. Carpenter had spoken of the reduction of cubic feet per ton produced, and the retorts scurfing so rapidly that they had to stand off at the end of three weeks. It appeared to him that they could not have been working the exhauster at a sufficient vacuum, or they must have been working with a very heavy seal. He never had anything of the sort. They scurfed not oftener than once in three months. There was no more scurfing required with inclined retorts than with horizontals. Then with regard to the charges creeping, about which Mr. Carpenter had said something two years ago, and now returned to the attack, with all his old vigour. After all, he did not think there was so much in this question as was made out; it was more of a bogey than anything else, put forward by the opponents of the system. He never had any difficulty. In fact, it was rather the other way. There had been some little difficulty in getting the coal to the bottom of the retorts; but they got over this by using a plate which the men on the charging-stage took along and placed in the mouthpieces. This allowed the coal to get more of a rebound. He should like to have asked if there was any depreciation in the illuminating power, which was another of the numerous bogies put forward. He had an opportunity last summer of working the inclined retorts alone, and sent out 16½-candle gas without any enrichment whatever. There was no doubt that some kinds of coal did answer better in inclined retorts than others; but with proper mixing, and knowing which coals would suit, there was no difficulty. He could not speak too highly of the system—more especially in gas-works of the size of those under his management. Now that the coalowners were putting their hands so freely into the pockets of gas companies, it was their duty to reduce the cost of production in every possible way; and he thought inclined retorts were the most economical and convenient system at the present day.

Mr. S. Meunier (Stockport) said he was rather glad to hear the criticisms on this paper; for when he first glanced at it, he began to think the step he had in view was likely to be a retrograde one. There was a certain amount of room in their retort-house, the output of which he wished to improve; and he had thought about doing this by the use of inclined retorts. But when he read the figures given in the paper, and compared them with his own actual working, he began to think that perhaps he was making a mistake. Mr. Carpenter had eight retorts in his setting, 20 feet long, 24 inch by 13 inch, and he only carbonized 9·12 tons in the 24 hours; whereas, with the same number of retorts 1 inch narrower and rather deeper, and of a similar length, he had no difficulty in dealing with at least 11 tons. He was rather struck some time ago with Mr. Carpenter's idea of one generator for a number of settings; but when he saw the figures given in the paper, he felt he should like to have some explanation from the author as to how it was that the cost of clinkering this generator appeared to be so high. It was 3·63d., which seemed very costly, even with the higher rate of wages paid in London. They could get it done with a single generator to each bed, instead of one to three beds, for 2d., though, of course, they did not pay the same wages.

Mr. C. E. Brackenbury (London) said when he first saw the title of the paper on the agenda it was "Inclined Retorts;" and he was led to suppose that the author was going to give a general review of the system in this country. Much to his regret, he found, instead of having the opportunity of discussing the general system, it was simply an account of the "Inclined Retorts at Bankside;" and he feared that the paper would not tend to remove, or even diminish, the generally accepted opinion that London gas engineers still lagged very much behind their Provincial brethren in this matter. Looking at the installation, they found that Mr. Carpenter had followed the Brentford gentleman, to whom every honour was due for having, in 1889, said the first word on inclined retorts in this country. They had not, however, said the last word; and there were other men, who were generally qualified to be considered pioneers, who had done a lot of practical work which had perfected the system. He should have liked to have asked Mr. Carpenter what steps he took before putting up this installation, and what works in the Provinces he visited, so that they might know what had guided him. The retort-house was an old one, in a most decrepit state; and ninety-nine engineers out of a hundred would have pulled it down, and put up a new one specially adapted to the plant proposed to be erected. As a consequence of this, there were eight retorts instead of nine or ten, and the considerable drawback of having only one stage instead of two. Under Mr. Herring, at Huddersfield, in 1892, a similar installation was put up; and, as it was not extended, it might be taken that it was not sufficiently successful to justify extension. The use of one ascension-pipe was many years old. With regard to taper, all the retorts he had had to do with were taper, and had given satisfaction as regarded facilitating the discharge of the coke, to a certain extent. He remembered, at Newcastle-under-Lyme, in 1894, a retort 16 feet long, with a taper of 6 inches, or 1 in 32, was put up, and reported on very favourably. There seemed to be some inconsistency about this question of taper, because in one place Mr. Carpenter remarked that "such a variation from parallel could not be of much moment either way," in connection with drawing the coke; and in the following paragraph he argued that "a set of taper charges in the retorts of the setting should mean a set of taper heats." It seemed to him that Mr. Carpenter was trying to have it both ways. If the taper could be ignored in one case, it certainly could be in the other. Theoretically it might be that if one had taper retorts one should have taper heats; but, as they all knew, it was a matter of no consequence in actual practice. The measuring chambers adopted were something beyond comprehension.

Why go to the trouble to have all the worm gearing for the purpose of opening the top doors of the measuring chambers simultaneously, so as to destroy at one blow the independent unit of the charging apparatus? He could not see any reason for it. He understood that all the measuring chambers were filled simultaneously by this gearing; and if, from any retort having dropped out of its ordinary rotation, one measuring chamber happened to be empty, it would be necessary to put in motion all the gearing to fill but one chamber. Why not adopt the plan usual in the Provinces, of having two slides with a single lever and "sure-feed" arrangement, so as to make the whole installation to a very large extent independent of the operator? There seemed to be a side light thrown on the difficulties experienced in working this installation, from the remark that the metals for the discharging trolleys "were kept clear of the coke-heaps made during each draw." They could understand from the arrangement of coke-heap against the retort-house wall, that they must have, on the ground floor of a house of this nature, a tremendous lot of wasted labour in keeping the rails clear, so as to facilitate the passing of the workmen, &c. The expense of a second stage was thus obviated, said Mr. Carpenter; but it also obviated its economy and convenience. Everybody agreed it was a retrograde step to go back to a single-stage house; and it was hardly worth pressing it further. The net result of the paper seemed to be that, out of four kinds of Durham coal, Mr. Carpenter had found one which he could use with inclined retorts. The Company he acted with used nothing but Durham coal; and this when charged was for the most part dust, so fine that many engineers would not care to use it. But in no single instance had there been the slightest complaint or trouble from slipping.

Mr. T. S. Lacey (London) asked what was the length of the retorts, and where the works were situated.

Mr. Brackenbury said they were 15-feet retorts. The works were on the Continent. It was not desirable to give the exact locality, as it was not a Company whose figures were obtainable; so that the mention of the name would not be of the slightest use. It was quite new to him that the creeping of the coal was found only in 20-feet retorts. He always understood that it depended on the angle, and the nature of the coal. The general length on the Continent was 15 feet; and this was the length of the retorts of which he had experience. Mr. Carpenter's make from his best-quality coal was 10,400 cubic feet per ton; and their average make from very small Durham coal was 10,600 cubic feet. He should like to know whether this installation was, in the author's opinion, a success or not. The general impression given him by the paper left him in doubt; but he hoped that Mr. Carpenter might soon have another opportunity of putting before them a better arrangement of inclined retorts, after having had experience in a house specially built for them.

Mr. Marshall said, according to his experience, the length of the retort had nothing to do with slipping.

Mr. J. Tysoe (East Greenwich) did not propose to enter into a general discussion of the paper, as it was a subject he was not practically acquainted with; but the installation had been very successful in its results. Previous to the introduction of the inclined retorts, the Bankside station was one of the dearest belonging to the Company in carbonizing wages; but it was now almost the cheapest. Great credit was due to Mr. Carpenter for the way in which he had carried out the work. He had encountered difficulties which were almost insurmountable; but he tackled the matter very pluckily, and brought it to a successful issue, as was proved by the results. It was not often they could get an authentic statement as to the cost of working inclined retorts. Indeed, it was a matter he had himself been looking at; for he could get no figures which it was possible to compare with stoking by machinery. But these figures, he believed, might be accepted as correct. At any rate, there were some champions of the inclined retort present; and no one had called the figures in question. He had taken out his own figures with regard to carbonizing machinery, in order to make a comparison between the two. Taking the cost per ton, the figures given by Mr. Carpenter, eliminating screening and picking, amounted to 16·08d. per ton of coal carbonized. With the machinery at his own works, the cost, taking precisely the same items, and working under practically the same conditions, was 11·91d.—in round numbers 1s., against 1s. 4d. But this did not exhaust the matter. The cost of the inclined retorts was given at £120 per 20-foot length, which he believed was about the usual. His own cost for the same work, including stage-floor, setting, and everything in connection with it apart from the building, and including the machinery necessary for working the retorts, amounted to £75 per 20-foot retort. This gave a a clear illustration of the fact that inclined retorts were not always superior to retorts worked by machinery. He had always held that machinery could be erected and worked cheaper than inclined retorts; and he had seen nothing up to the present to cause him to alter his opinion.

Mr. Herring asked what was the minimum quantity of gas made at the works where the cost came to 11·91d. The machinery must be worked up to its full capacity.

Mr. Tysoe replied that, in the case of the Bankside works, machinery was out of the question, on account of the smallness of the place. To make machinery successful, it should be always at work; and the full quantity of retorts should be charged. In his own case, the number of retorts served by one set of machines was 300.

Mr. Marshall said that Mr. Tysoe was rather unfair to those who had read papers before on this subject, in saying that no figures had been given. He had himself endeavoured to give the true state of the case.

Mr. S. Y. Shoubridge (Lower Sydenham) said Mr. Carpenter's design had been rather severely criticized; and it was a great pity he was not present to reply. The paper, so far as he had read it, did not assume that Bankside had an ideal installation. But Mr. Carpenter had been good enough to show what he had done there; and whether they agreed with the plan or not, they were quite as likely to learn from mistakes as from successes. At any rate, whether or not it was as successful as it might be, Mr. Carpenter had been good enough to put his design at their disposal; and he thought they were much obliged to him for it. With regard to the cost of working, this had been mentioned. If Mr. Tysoe would refer to the "Journal of Gas Lighting," he would find that inclusive figures had been given of the cost of working inclined retorts at several places. At Dewsbury, for instance, the total figure was given as 1s. 2d. per ton, including all charges, from the coal into the house to the coke into the yard.

Mr. Tysoe said what he meant was that he had no figures which could be compared with the cost of machine stoking he had given, until Mr. Carpenter supplied them in his paper. These were comparable, because both works belonged to the same Company, and the rates of wages were similar.

Mr. Shoubridge said it was hardly fair to compare such a splendid installation of stoking machinery as Mr. Tysoe had at East Greenwich with the admittedly cramped arrangement at Bankside. A fair comparison could only be made where all the conditions were equal. For this reason, he did not give, in the paper he had read before the Gas Institute, all the figures relating to cost, but simply those which were effected by the improvement in the system. The method of getting out coke varied in almost every works. In some it cost more than in others; and the same with the getting in of the coal. These things were not peculiar to the inclined retort system; and wherever they could be eliminated, they should be. To compare all-round figures was quite as misleading as to take them partially. With regard to taper retorts, being the first to use them, he should like to say that his experience had fully justified the alteration. The taper did facilitate the discharge of the coke very considerably, and did not affect the heats. Mr. Carpenter's assumption was therefore incorrect. Perhaps one reason why Mr. Carpenter had not attained full success with his setting was that he adopted a small retort. He reduced the height, because he was not going to put in rakes, and also because he adapted an arrangement for charging which was decidedly imperfect. These two things were the main causes of his want of complete success.

The President said a report of the discussion would be furnished in due course to Mr. Carpenter, who, he hoped, would be able to make some reply.

On the resumption of the proceedings next day,

The President stated that he had received a letter from Mr. Carpenter, stating that it was quite impossible for him to attend the meeting. He would, however, reply through the press. [Mr. Carpenter's remarks have since been received; and they appear in our "Correspondence" columns to-day, p. 1305.]

THE PRESENCE OF NAPHTHALENE IN COAL GAS: ITS DETECTION AND EXTRACTION.

By WILFRED IRWIN, of Manchester.

When your President invited the writer to read a paper on the naphthalene question before the annual meeting of the Institution he hesitated at first, as it appeared to be presumptuous for an outsider, who is neither a gas engineer nor in any way officially connected with a gas-works, to try to instruct those who from their youth up have had ample means of studying the subject. Following, however, the advice of the late Master of Balliol, "Never apologize, never explain," the author will, without delay, plunge into the subject in hand.

Of the many hindrances which have stood in the way of the more rapid development of the gas industry, few perhaps have, of late years, caused more annoyance and irritation to the engineer than the deposition of naphthalene in a solid form in the mains and service-pipes. To describe a method of preventing these deposits, was the primary aim of this paper; but in its preparation the scope widened, and the writer came to the conclusion that, to deal with the whole question of condensable products in coal gas, would greatly assist in the proper understanding of the naphthalene trouble.

Naphthalene ($C_{10}H_8$) was first discovered in 1820, by Garden, in the fractions of coal-tar oils boiling between 200° and 250° C. It is a white crystalline solid, melting at 79° C.—boiling-point 218° C. When condensed from a vapour, it deposits in white thin rhomboidal crystals, which occupy an enormous amount of space, and a cubic foot of which, according to Rosere and Schoelemmer, only weighs ¼ oz. It forms one of the principal condensable constituents of coal gas; 1 ton of coal yielding as much as 13 lbs. of naphthalene. And here the writer will take the opportunity to bring before you a rather unusual aspect in which to regard ordinary coal gas as it leaves the retorts.

Leaving out of consideration the water and ammoniacal and sulphur products, it has usually been the custom to consider gas as it leaves the retorts as composed of permanent gas and tar—no account being taken of the fact that the former contains large quantities of condensable bodies. In place of this, let us regard it as a mixture: (1) Of gases, each of which by itself is a permanent gas at the ordinary temperature. (2) Of condensable constituents, by which are meant bodies liquid or solid at the ordinary temperature.

With the permanent gases—consisting chiefly of hydrogen, marsh gas, ethylene, and acetylene—we do not need to concern ourselves at present. It is the condensable constituents—their composition and properties—which the writer wishes to bring before your notice to-day. After the gas leaves the retorts, these mostly condense to form tar; but considerable quantities also remain in the gas—quantities dependent partly on the proportional amount present in the gas as it leaves the retorts, but chiefly on their vapour tensions.

Here, then, is a table prepared by the writer, in which:

TABLE *showing the Condensable Constituents of Gas produced by One Ton of Lancashire Coal Carbonized at High Temperatures.*

Name, with Formula and Boiling-Point.	1 Total Weight of Same.	2 Amount in Tar.	3 Amount in Gas.	4 Vapour Tension at 15° C.	5 Illuminating Power of the Gas due to the Presence of each Constituent (approximate).	6 Additional Gain to the Illuminating Power of the Gas if each of the Lighter Constituents was Transferred from the Tar to the Gas.	7 Percentage of Gas Saturated with each Product (approximate).	8 Solubility in 1000 parts of Water.
	Lbs.	Lbs.	Lbs.	Mm.	Candles.	Candles.	Per Cent.	
Benzene (C_6H_6, 80·4° C.)	18 80	0·8	18·00	61 00	8·60	0·40	10·1	1·45
Toluene ($C_6H_5CH_3$, 111° C.)	6·70	0·7	6·00	19·40	3·00	0·35	8·9	0·57
Three xylenes ($C_6H_4[CH_3]_2$, 137–141° C.)	1·40	1·0	0·40	6·30	0·20	0·60	1·6	0·12
Three bumenes ($C_6H_3[CH_3]_3$, 163–169° C)	0·50	0·3	0·20	1 50	0·10	0·16	2·8	
Higher methyl derivatives of benzene	0·20	0·1	0·10	0·40 (?)	0·05	..	5·7	
Naphthalene ($C_{10}H_8$, 218° C.)	13·15	13·0	0·15	0 03	0·10	..	70·0	
Phenol (C_6H_5OH, 184° C.)	1·00	1·0	..	..	..	..	..	50·00
Three bresols ($C_6H_4CH_3OH$, 188–201° C.)	0·80	0·8	..	..	..	..	..	20·00
Pyridine and lower methyl derivatives (C_5H_5N, 117–140° C.)	0·30	0·3	..	..	..	..	..	very soluble
Phenanthrene ($C_{14}H_{10}$, 340° C.)	1·00	1·0						
Anthracene ($C_{14}H_{10}$, 360° C.)	0·30	0·3						
High boiling oils	22·70	22·7						
Pitch	93·00	93·0						
Totals	159 85	135·0	24·85	..	12·05	1·51	99·1	..

Note.—The pyridine and phenol, though having comparatively low boiling-points and vapour tensions, do not appear in the gas, as they are extracted along with the ammonia salts, they being very soluble in water. The values for illuminating power were determined by means of the ordinary No. 4 union-jet burner. With the argand burner, the figures in column 5 would be something over half those given above, and those in column 6 would be considerably less than half.

Column 1 shows the quantity of each per ton of coal carbonized at fairly high temperature. Columns 2 and 3 show how they distribute themselves between the tar and gas. Column 4 shows the vapour tensions of the more volatile products, as determined by the writer. Column 5 shows the gain to the illuminating power of the gas due to the presence of each of the aforesaid products. Column 6 shows the additional gain in illuminating power of the gas, if all the lighter products were extracted from the tar and transferred to the gas. Column 7 shows the percentage of gas actually saturated with each of the lighter products. Column 8 shows their solubility in water.

The significance attaching to the table will be readily recognized. The first point to notice is the relatively large amount of the primary aromatic bodies, benzene and naphthalene, and the decreasing amounts of the methyl derivatives of benzene with each addition of methyl to the molecule.

The writer has found that the higher the temperature of carbonization, the greater does the proportional amount of both benzene and naphthalene become; the increase being at the expense of their methyl and phenol derivatives. This accounts for the increase in the naphthalene trouble, with the rise in the temperature of carbonization in recent years, for some of the aforesaid derivatives have vapour tensions near to that of naphthalene; hence the smaller the quantity of these in the gas, the greater likelihood there is that naphthalene will be deposited in a solid form.

The next point to notice is the small proportion of gas which is saturated at the ordinary temperature with the lighter liquid products—benzene and its derivatives—leaving the remainder to be, for the most part, saturated with vapour of solid naphthalene. This substance is the last with an appreciable vapour tension at ordinary temperatures; and it is present in very large quantities. Hence all the gas which is not saturated with the lighter products will be saturated with naphthalene. To examine minutely the conditions under which the various volatile bodies in coal gas as it leaves the retorts will distribute themselves between the gas and tar, would occupy too much time, as the question is very complicated; but we may take it that about 70 per cent. of ordinary coal gas at 15° C. will be saturated with naphthalene.

The law governing the whole process is known as Regnault's law of vapour tension, which states: "When two liquids dissolve in one another in all proportions, then the tension of the vapour of the mixed liquids is intermediate between the tensions of the separate liquids."

Another point to notice is the influence which each of these bodies has on the illuminating power of the gas. The estimations were made with a No. 4 union-jet burner. When they are all extracted, the residual gas has an illuminating power of about 1 candle; though if the ordinary standard argand were employed, it would test nearer 9 candles. If the latter burner had been used, the figures in Column 6 would be considerably under half the various

amounts given. From this we gather that, with the ordinary method of testing, the total possible gain to the illuminating power of the gas by the transference to it of everything of illuminating value in the tar, cannot represent more than 0·6 candle.

This clearly demonstrates the futility of all processes for raising the illuminating power of the gas based merely on alterations in the method of condensation; for under no conceivable circumstances (without resorting to distillation) could the quantity of lighter products in the tar be reduced by more than one-third.

The interest of the figures in Column 8 may not be apparent at first sight; but they were the result of a research by the writer into the cause of the loss of illuminating power by passing gas through a wet meter until the water had become saturated. The loss of illuminating power was proved to be due to the material solubility of benzene, &c., in water—a fact unknown before. The decrease in solubility with the addition of methyl to the benzene nucleus, was also an interesting fact brought out at the same time.

The whole table is a revised compilation from work done at various times by the writer, and communicated to the Society of Chemical Industry in Manchester during the past few years.

Cause of Naphthalene Deposits.

The writer's experiments showed that the vapour tension at 15° C. is 0·03 mm., at 25° C. 0·08 mm. Hence the quantity of naphthalene capable of being held in the form of vapour decreases very rapidly with a reduction in temperature. In this it follows the general rule, that the further a vapour is reduced in temperature from the boiling-point of the liquid, the greater is the proportional reduction in its tension for a given number of degrees of heat. At 25° C., gas may contain as much as 0·45 lb. per 10,000 cubic feet; at 15° C. it will only hold 0·15 lb. Hence if gas were sent out from the holder at 25° C. into the mains at 15° C., then 0·3 lb. of naphthalene per 10,000 cubic feet would be precipitated. This, of course, is an extreme case; and if plenty of time for thorough condensation be given at the works (so as to prevent the gas going forward in a supersaturated condition), and the temperature of the air never varied, the presence of a little naphthalene in the gas could not cause trouble. Such conditions, are, however, impossible, taking into consideration climatic variations, which may be roughly divided into (*a*) diurnal, (*b*) annual.

(*a*) *Diurnal.*—Gas made on a hot day is always liable to deposit naphthalene in the street-lamps on a cold night at any time during the year, but most commonly in the late spring, when diurnal variations in temperature are usually the greatest.

(*b*) *Annual.*—In the winter, the mains are often warmer than the gas leaving the works. Hence if the mains be clear to start with, little trouble from naphthalene is experienced. Through the summer the mains are cooler than the gas as it leaves the works; and naphthalene is continually depositing in them. But not much gas is being consumed, and its presence in the mains is often scarcely recognized. The temperature of the street-lamps is higher than the mains; so that naphthalene will be carried forward through them without deposition. As the nights begin to cool and lengthen, more gas is required, and the stoppages in the mains begin to be felt. The temperature of the street-lamps becomes lower than that of the mains. Hence, although the gas may be well cooled and free from naphthalene as it leaves the works, it will pick it up again from the mains and deposit it in the street-lamps and services.

From the above, it will be gathered that, in the opinion of the writer, the naphthalene trouble is entirely dependent on climatic variations—always supposing, of course, that ample condensing power exists at the gas-works. To account for all its vagaries in its choice of places of deposition would be very difficult; but in this it in no way differs from other deposits from supersaturated liquids or gases.

Prevention of Naphthalene Deposits.

Referring again to the table. All the condensable bodies —*i.e.*, those in Column 3—can be extracted from gas by washing it in a suitable apparatus with heavy tar oil. About eighteen years ago, the writer began experiments with a view to extracting them on a commercial scale, as the market was very favourable. The experiments were successful; and large quantities of benzene, toluene, &c., obtained from this source were soon placed on the market, which was materially affected thereby.

About 70 gallons of oil per ton of coal were found to be sufficient to extract the whole of the condensable constituents from the gas. If less than this amount were used, the more volatile bodies would pass on without condensation; and the writer soon discovered that it was only a matter of the quantity of oil employed, as to whether the whole or only the least volatile of the products were condensed.

In the autumn of 1898, his friend Mr. J. P. Leather, of the Burnley Gas-Works, consulted the writer as to the best method of preventing naphthalene deposits, with which he was troubled at the time; and relying on the experience just alluded to, he (the writer) suggested washing the gas with oil to which a quantity of benzene had been added, to prevent any deterioration in the quality of the gas.

The first obvious requirement, however, was to obtain an approximate idea of the amount of naphthalene which the gas contained. This is just what no previous experimenter had ever done—perhaps owing to the fact that no method of testing for the same had appeared in any work dealing with gas analysis. One had, therefore, to be devised; and the writer suggested the passing of a large volume of gas—say 400 or 500 cubic feet—through benzene or toluene contained in two absorption flasks arranged consecutively. A considerable amount of the solvent is required, as 400 cubic feet of gas will take up nearly half-a-gallon of benzene, though, of course, much less toluene. To start with, 400 c.c. of the solvent can be placed in each flask; and more can be added to supply that lost by evaporation. In this operation, all the higher boiling hydrocarbons are caught in the flasks, and benzene takes their place in the gas. The contents of the flasks are now submitted to fractional distillation through a dephlegmating column, and the naphthalene crystallized out from the last residue by cooling. The result was that the Burnley gas was found to contain 0·13 lb. of naphthalene per 10,000 cubic feet. The other high-boiling hydrocarbons may be estimated at the same time. This, of course, is not a scientifically accurate test; but it yields approximate results, and as a comparative test it is certainly very valuable. It yields the naphthalene in a form in which it can be seen and examined; and Mr. Leather and the writer have found it very serviceable in connection with their process for extracting naphthalene from gas.

A few months ago, Dr. Colman and Mr. Smith, of the Birmingham Gas-Works, applied Kustner's method of testing naphthalene to the estimation of the same in coal gas. They pass 100 cubic feet through a solution of picric acid in water; and from the weight of naphthalene picrate precipitated, the amount of naphthalene in the gas may be calculated. The only possible weak point about this test is the extent to which other picrates may be mixed with the precipitated naphthalene salt. If the precipitate is practically pure, the test will be most valuable; but the writer is of opinion the results will be rather too high.

The figures given above dispose of the idea that in extracting naphthalene one is in any material degree diminishing the illuminating power of the gas.

A spare scrubber was available at Burnley; and experiments with various oils showed that the oil absorbed naphthalene from the gas until it contained 10 per cent., when it had to be changed. Hence it follows that, according to the temperature, from 13 to 40 gallons of oil per million cubic feet of gas is the amount necessary to extract the naphthalene; and the addition of 8 per cent. of benzene prevents any loss of illuminating power in the gas.

The following, then, is the exact statement of the process, as patented by Mr. Leather and the writer: The gas, after it has been cooled and freed from tar, is treated with a small quantity of a mixed liquid capable of absorbing naphthalene, and which, at the same time, will not deteriorate the quality of the gas by absorbing benzene or other illuminating substances therefrom. The liquid to be used in the process must be—(*a*) Practically free from naphthalene. (*b*) Capable of dissolving naphthalene. (*c*) Must give off at the ordinary temperature a vapour whose tension and effect on the illuminating power of the gas is such that the loss of illuminating power occasioned by the extraction of naphthalene and other substances is more than compensated by the gain from other substances taken up by the gas from the liquid itself.

The following are suitable mixtures—

Blast-furnace oil 92 per cent. benzene 8 per cent.
Heavy tar oil 92 ditto benzene ditto

Gas at 60° Fahr. would require 15 gallons, at 70° Fahr. 25 gallons, and at 80° Fahr. 40 gallons of the above mixture per million cubic feet. After absorption of 10 per cent. of naphthalene, the low-boiling hydrocarbons may be extracted therefrom by distillation, and recovered for mixing with a fresh quantity of oil for future use.

The plant recommended is a washer in which the liquid can travel in a direction contrary to that of the gas, through a series of chambers in each of which it can be brought into intimate contact with the gas. An apparatus half the size of that usually employed for the extraction of ammonia will be found sufficient. (For economy, Mr. W. Young's washer, as supplied by the Oil-Gas Enrichment Company of Edinburgh, is recommended.)

After taking out the patent, it was discovered that the principle of washing a gas with oil for the extraction of naphthalene was foreshadowed in a patent taken out in 1896 by Messrs. Young and Glover; but no figures were given by them, and an arrangement has been arrived at between the patentees to work in unison.

Before concluding, it may be useful to note the effect on the illuminating power of gas by washing the same with (1) heavy tar oil, (2) heavy tar oil and 8 per cent. of benzene, (3) benzene alone, and (4) naphthalene. The first almost entirely robs it of its illuminating power, the second leaves it the same as it enters, the third enormously enriches it, and the fourth leaves it practically the same when in a solid form, though when dissolved in another solvent it acts as a powerful absorbent of benzene, and hence of the illuminating power. This demonstrates that the fears of some gas engineers, that solid naphthalene in the mains has a prejudicial action on the gas, are quite groundless.

Discussion.

Mr. A. F. Browne (Vauxhall) said it was some years since he first came across the records of Mr. Irwin's work in connection with the subject of the hydrocarbon vapours in coal gas; and Mr. Irwin had shown, as regarded commercial results, that the subject became more important as time went on. To-day Mr. Irwin had rounded off, as it were, their obligation to him, by bringing before them a paper which was of very great theoretical interest, and possessed, he thought, also considerable practical value and importance. The dominant note of the discussions during the meeting might be said to have been very candid criticism; but no man whose opinions were worth attention would object to that, and he only alluded to the matter for the purpose of saying that if he should be so unfortunate as to appear to transgress the limits of courtesy and good taste, he hoped he might be forgiven. They had in the paper a very plain statement that, inasmuch as 10,000 cubic feet of ordinary coal gas was saturated with the lighter hydrocarbon vapours to the extent of 30 per cent., the gas was therefore unable to be saturated beyond 70 per cent. of its volume with the vapour of naphthalene; and in support of this theory, Mr. Irwin had quoted Regnault's well-known law of vapour tension. But upon this, he would ask Mr. Irwin the very plain question, Did the law quoted necessarily compel the conclusion, or even support that contention? To put the matter as it would be put in the text-books, it appeared to him that Mr. Irwin's meaning was that the vapours of two hydrocarbons which dissolved one another in all proportions could not be saturated in the presence of each other in a given space at a given temperature. He would ask Mr. Irwin if he had any justification for his theory, because in the paper there seemed to be some slight ambiguity on the point. Mr. Irwin told them that 10,000 cubic feet of coal gas, at 15° C., was able to hold, in the form of vapour, 0·15 lb. of naphthalene; but in the table they also found the statement that 0·15 lb. of naphthalene was only able to saturate 70 per cent.—the remaining 30 per cent. being already saturated with the lighter hydrocarbon vapours. He had not asked the question to display his ignorance, but because he really wanted to know the truth of the matter; as it would be within the memory of those present that a very interesting paper had lately been read by Mr. Allen upon this very question, in which he made a statement of a precisely opposite character. The very interesting experiments detailed in Mr. Allen's paper went to show that, not only did coal gas at a certain temperature carry as much naphthalene vapour as did atmospheric air, hydrogen, carbonic oxide, or whatever it might be, but they showed that, if the atmospheric air was saturated at a temperature of 60° with the vapours of certain light hydrocarbons, and raised to 140°, it would carry more naphthalene vapour than air, hydrogen, marsh gas, &c., at 140° Fahr., but containing no hydrocarbon vapours. The experiments also went to show that coal gas itself, raised to a temperature of 140° Fahr., and then saturated with the vapours of the lighter hydrocarbons, and passed through tubes containing solid naphthalene, would, under those circumstances, carry a far larger quantity of naphthalene than it had done before at 140° Fahr., though, as one might suppose, this would be thrown down in the cooler parts of the apparatus, which would be choked by the precipitated naphthalene. Upon this point, it seemed to him that they had a difference between the statements of two scientific gentlemen on a very important matter, which, at this time of day, ought not to be in doubt, with reference to a subject which had created so much interest in the minds of gas engineers as that of naphthalene. Passing on to the causes of naphthalene deposits, he found it stated that, at a temperature of 60°, or thereabouts, 10,000 cubic feet would carry 0·15 lb. of naphthalene; and they were told that the naphthalene in a million cubic feet of gas could be washed out by the employment of a mixture of 92 per cent. of oil and 8 per cent. of benzene in a total quantity of 15 gallons—that was to say, that 1 gallon of the mixture would wash out 1 lb. of naphthalene. What was surprising about the statement, was that the quantities were so small; and not only was the total quantity small, but the percentage of benzene was very small indeed. Eight per cent.—or, say, 10 per cent.—of benzol, would mean that it was only necessary to employ a total quantity of 1½ gallons of benzene in the washing process, to get rid of the naphthalene from a million cubic feet of gas. If that was so, it was not only a very remarkable but a very cheap process, because the heavy oil could be returned to the tar-well; and naphthalene being a commercial product, the tar distiller would not at all object to it. With regard to this, he would like to ask a further very straightforward question—namely, whether this process had really been tried upon a commercial scale, and whether the figures given could be substantiated; because he found it stated that where liquid benzene was employed to dissolve out naphthalene in coal gas, 400 cubic feet of gas only would take up in the form of vapour ½ gallon of benzene. It was also said that the agent employed must be able to give off, at ordinary temperature, a vapour whose tension and effect upon the illuminating power of the gas were such that the loss of illuminating power occasioned by the abstraction of naphthalene and other substances was more than compensated. What was contemplated, therefore, was that the benzene should be given up to the gas to supply the place of the naphthalene and other substances. It appeared to him an extraordinary thing that 1½ gallons of benzene should do this work, and that there should be no depreciation of the hydrocarbons existing in the gas by the washing action of the heavy oils. The only possible objection to the proposal that he could see, was that it would require special apparatus. The first cost of apparatus was but a small consideration; it was the working charges which had to be considered. The only mechanical objection that he could find was that, a washer being employed, it was very likely that the pressure in the exhauster-house would be raised by several inches; and this might sometimes be a matter of considerable inconvenience. As to the author's statement about the value of naphthalene in coal gas as an illuminant, he thought many of them would have been loth to part with naphthalene if they could possibly have retained it, owing to their having had an exaggerated notion of its value as an enricher. But all the evidence, he thought, went to show that from this point of view it was not worth thinking about, and that it was to be regarded simply as a nuisance that should be got rid of as soon as possible. When they were plainly told that the illuminating value obtainable was really only 0·1 candle at 60° Fahr., it was obviously a mere bagatelle. He would like to add that it appeared to him that they were at last upon the right track as regarded the method to be employed in dealing with naphthalene.

Mr. T. Glover (West Bromwich) said that in 1897, in a discussion on this subject, he had ventured to throw out

some ideas as to the causes underlying the naphthalene trouble; and in the same year he read a paper before the Gas Institute, giving the ideas of himself and two colleagues as to the best methods to be employed in freeing coal gas from naphthalene. On that occasion, he believed he was the first to draw attention, before a body of gas engineers, to the fact that naphthalene was a high-temperature product, and to point out that the natural preventative for subsequent deposits was to wash it out with solvent oils. He purposely refrained at that time from giving figures as to the quantities of oil which might be required to do the work of naphthalene removal; but from that year to the present, he and his colleagues had never let the subject alone. As the members were well aware, the testing of new processes on a working scale always took considerable time. He was glad, however, that Mr. Irwin had, in his paper, confirmed the theories put forward in 1897. He (Mr. Glover) believed the methods employed would commend themselves to every thinking gas engineer. The laws as to the formation of naphthalene were now understood; and he believed the method of washing out, which was both simple and effective, would be appreciated. To compensate for the loss of illuminating power due to the absorption of illuminants by solvent oils, a small quantity of benzol was added to the washing agent; but this addition must not be considered as interfering in any way with the action of the oil, except to prevent the loss in illuminating power when the process was first started. Mr. Irwin had given them a figure which he had found suitable—viz., 8 per cent. of benzol. He (Mr. Glover) thought the thanks of the Institution were due to Mr. Irwin, who, he noticed, had spoken of himself as an outsider. But the Institution were always glad to welcome those who were working upon subjects similar to those engaging the attention of their own members.

Mr. W. E. Price (Hampton Wick) thought it might be of interest if he related an experiment which he had made after having studied Mr. Leather's paper read at the Gas Institute. He inquired as to what oil was available, green oil having been mentioned as being suitable; and he was advised by the tar distiller that creosote oil would probably be more suitable than green oil, as it contained less naphthalene. He tried it on a large scale, taking the whole of his gas; and he put it in the top tray of a Walker purifying machine. He arranged it so that the water, instead of going into the top tray, went into the second; and he filled the first tray with green creosote oil. This was in November last. Three hundred gallons of oil filled the chamber; and he passed, roughly speaking, 15 million cubic feet of gas through it. He then withdrew the oil, because he found he was getting naphthalene complaints. During the time the oil was used, naphthalene complaints most distinctly reduced in number. After a time, they increased; and he then withdrew the oil, and had sent it away to be analyzed. Unfortunately, at the present time he had not been able to ascertain the exact composition of the oil. That worked out at twice the quantity mentioned by Mr. Irwin. After this, he tried the same oil in a Kirkham's "Standard" washer; putting it in the last tray. He found it as useful. He thought they were on the right track in following this plan.

The President: May I ask whether you used any benzol.

Mr. Price said he used no benzol, nor any extra enrichment whatever. He had an enricher, using benzol, which was employed when required; but without that, he could say there was not a drop of half a candle in the illuminating power due to the use of creosote oil.

Mr. C. E. Botley (Hastings) said the paper was particularly interesting from two points of view. They had now put before them the quantity of naphthalene which might be discovered in coal gas, and the fact that the amount it contained had very little effect on the illuminating power. With the general contentions of Mr. Irwin's paper, he could thoroughly agree; and he was of the same opinion as to the effect of climatic conditions on the production of naphthalene. There was no doubt that, whatever steps they took, they could not control their condensation exactly as they would wish, owing to climatic conditions. At Hastings, they withdrew the excess of naphthalene before distributing the gas. He did not think that this was a washing process. Taking the hydrocarbon which they employed, if they washed the gas with it, they would take away a part of the illuminating power. If they took it and sprayed it into the gas, it would have very little effect on the illuminating power, and also on naphthalene deposits, except locally. In their own case, the oil was introduced in the form of minute atoms; and what was wanted was to carry these atoms to the extreme end of the district. This they did; and after six years' experience, he did not think it could be alleged that they made any mistake about it being so. There was one fact brought out by the paper, and that was that at the present time, whichever process might be employed, it was not open to say there was no cure for the naphthalene deposits which had been a bugbear to them all. He might be pardoned, however, for believing that the process they used at Hastings was more generally applicable; and it was certainly far simpler, and very much cheaper in application.

Mr. Price said he wished to add that, in his experiment, the quantity of oil used worked out at 20 gallons per million cubic feet.

Dr. H. G. Colman (Birmingham) said, with regard to abstracting naphthalene on a large scale, there appeared to be no doubt that either of the processes proposed by Mr. Irwin and Mr. Botley would effectively get rid of naphthalene; and the choice between the two depended largely on the cost. Neither of them, in his opinion, would form the final solution of the difficulty. Both were methods of "cure"—extracting the naphthalene which had escaped removal in the condensers—whereas, for thoroughness, he believed it was necessary to so modify the cooling process that the whole of the naphthalene should be retained in the tar. The question of the expense of the washers was a considerable one. Assuming that it took only one-half the washer area required for ammonia, the amount for interest on capital, depreciation, &c., would come to an item that was not inappreciable. With regard to the liquid used, Mr. Irwin gave 8 per cent. of benzene. This was at Burnley, where the illuminating power was 18 candles. Mr. Price, with 16-candle gas, did not find any appreciable diminution of illuminating power. The amount of benzene to be added to the oil would depend on the illuminating power of the gas and the kind of oil used. As to the quantity of naphthalene in coal gas, it might be of interest if he gave them the results which he had obtained during the past few months, although they were probably not as interesting as those they would get during the summer. From the time they had been able to work the picric acid test, all naphthalene trouble had disappeared, as was usually the case in Birmingham in the winter. In December, January, and February, naphthalene had varied from 1½ grains per 100 cubic feet to nothing. But during March, the quantity steadily rose from 2½ to 3½ grains; and in the middle of April, to 4½ grains. Ten days ago, there was a spell of warm weather; and the amount of naphthalene at once rose to 9 grains per 100 cubic feet. At the end of the week, when the weather was colder, it dropped again to 5 grains. At another works, no naphthalene had, up to the present, been detected in the gas. He should be extremely glad if others would obtain similar information as to the way in which naphthalene varied with the atmospheric temperature at their own works. There had not, he believed, been a single naphthalene stoppage reported in Birmingham this year; and in previous years there were not, as a rule, any complaints of stopped service-pipes up to the end of May.

Mr. S. Glover (St. Helens) said that, as one of the original workers of the process described, it had given him very great satisfaction to hear from professional brethren the experiences they had had, and the work they had been able to do, in this matter. They were all pleased to have the experience of Mr. Price; but he thought he failed to have complete success, owing to the apparatus he used. If he had carried out the process in a more correct form of apparatus, and had given it several washings, it would have been different. Mr. Irwin had stated the quantity of washing oil required. This might be left out, because it so depended on the quantity of naphthalene in the gas as it came from the gas-works; and it would have to be found out in each particular case what would be required to do the work completely. In 1874, Mr. Young read a paper before one of the Scottish Associations, in which he described the advantage of using heavy oils, as the hydrocarbon constituents could be then more rapidly and correctly obtained. The success of the process, as described by Mr. Irwin, was assured; and its simplicity would certainly recommend it.

Mr. C. F. Botley (Hastings) said that, having had experience in washing gas with oil, and getting into serious trouble in the matter, he could not help being struck with the view that it was a very ticklish thing to do. Mr. Price had given them his experience for a very brief period—brief in connection with naphthalene—wherein he found that washing with creosote oil did not affect the illuminating power by more than half a candle. That was extraordinary, from his (the speaker's) point of view; and considering the will-o'-the-wisp nature of naphthalene, there was nothing conclusive to be drawn from such a three months' test. It was not necessary to abstract all the naphthalene to prevent trouble with it.

Mr. T. S. Lacey (London) said naphthalene troubles did not confine themselves to the district supplied, but were often to be found at the works. He should like to ask if there was any difficulty in putting the apparatus at the inlet of the scrubbing apparatus, so that the naphthalene could be removed before the ammonia. If the process could be used before the scrubbers and washers, the spare scrubbers might be employed in some way to do the washing; and little extra expense would be entailed.

The President, in calling on Mr. Irwin to reply, said he wished to make no remarks of his own. He thought they had learned a good deal from the paper and discussion. The point Mr. Lacey had raised was an important one. Naphthalene did cause them some difficulty; but if they were going to take it out, they should take it out at the works.

Mr. Irwin, replying to the discussion, said, in answer to Mr. Browne, as to the amount of naphthalene which could be absorbed by gas, supposing two substances had exactly the same boiling-point, or near the same vapour tensions, then Regnault's law held absolutely. When they were as far apart as benzene and naphthalene, then Regnault's law was not quite correct. To a certain extent, benzene acted as a gas towards naphthalene. Therefore his calculations were not mathematically right; but they were near enough for all practical purposes. As to the figures, Mr. Browne had called attention to the fact that gas at 25° C. might contain 0·45 lb. per 10,000 cubic feet; while at 15° C. it would only hold 0·15 lb.

Mr. Browne said that the point he drew attention to was this—that at one part of the paper it was stated that 0·15 lb. of naphthalene would saturate 10,000 cubic feet of gas, but at another part of it it was said that it would saturate only 7000 cubic feet. The table gave the figure of 7000 cubic feet, and the paper said 10,000 cubic feet.

Mr. Irwin (continuing) said, with reference to the percentage of benzol required in the oil, he would point out that it was not the benzol that was extracting the naphthalene. Benzol was added to prevent the oil absorbing any more benzol from the gas. It required 70 gallons of oil per ton of coal to extract all the illuminating agents. Hence, the possibility of such accidents as Mr. Botley had predicted was very remote. The amount of benzol required varied with the quality of the oil, and of the gas. Mr. Glover's experiences were amply borne out by his (Mr. Irwin's). He should like to know if there was much naphthalene in the creosote oil used by Mr. Price.

Mr. Price: No.

Mr. Irwin (continuing) said, in the North of England their green oil was much freer from naphthalene than their creosote oil. Dealing with any loss of illuminating power from the presence of naphthalene in the service-pipes, he said it came to almost nothing; and the maximum loss could be easily determined. He could state absolutely that dry naphthalene did not absorb any of the illuminating power of the gas. Mixed with other oils, there was a slight absorption of benzene, and therefore of illuminating power. The cost of the process at Burnley was very small—a fraction of a penny per 10,000 cubic feet. It worked perfectly satisfactorily at Burnley, and as they had just heard, at Hampton Wick. Many gas engineers with whom he had corresponded had said that their principal trouble with naphthalene was on the works.

NOTES ON CARBONIZING CANNEL AND SHALES FOR GAS-MAKING PURPOSES.

By S. Glover, of St. Helens.

The main object in using cannel in the ordinary manufacture of illuminating gas, is to increase the illuminating power. The removal of naphthalene happens to be an accompanying advantage. The volume of the cannel gas is not so material an object as enrichment. This is shown by the fact that benzol (which adds an exceedingly small volume to the gas) is in many cases used in preference to cannel. In carbonizing cannel, it is therefore evident that the primary object to aim at is not production of volume, but to carbonize it at such a temperature as will produce the maximum enrichment value. It does not pay to crack-up the valuable enriching hydrocarbons to obtain volume of gas. This can be secured much more cheaply from the ordinary gas coals.

As you are aware, cannel coal and bituminous shales (such as are used to enrich coal gas), when destructively distilled or carbonized at the lowest possible temperatures, yield what is known as paraffin or shale oil. These oils contain such a small quantity of acid and basic hydrocarbons, and such a large quantity of hydrocarbons belonging to the paraffin and olefiant group of hydrocarbons, that they can be economically used for the production of lamp oil and paraffin wax.

Ordinary bituminous gas coals, when similarly carbonized at low temperatures, owing to their different structural constitution and percentages of the carbon, hydrogen, oxygen, nitrogen, &c., which they contain, yield very different kinds of oily products; and these hold such a low percentage of the paraffin and olefiant group of hydrocarbons, and such a large proportion of acid, basic, and other series of hydrocarbons, which have to be removed by chemicals, that they cannot be economically used in the manufacture of lamp oil and paraffin wax.

When oil from shale or cannel are cracked-up in retorts at gradually increasing temperatures, the volume of gas increases with the rises of temperature, and for a time (at the lower temperatures) so also does the illuminating power—or, at least, it does not decrease. But as the temperature is further raised, and the volume of gas increases, the illuminating power begins to decrease. For a time, it does not decrease so quickly as the volume increases; and consequently the gross illuminating value of the gas obtained from the oil continues to increase. At still higher temperatures, the illuminating power begins to decrease more quickly than the volume increases, when, of course, the gross illuminating value of the gas obtained from the oil is distinctly less.

In carbonizing oil by itself, the aim would therefore be to carbonize it at the temperature at which the volume and illuminating power were balanced—that is, when one portion of the oil had been cracked-up into volume of gas, to take up the remaining sufficiently volatile hydrocarbon vapours in diffusion, and prevent them being deposited in the tar.

Now it is evident that, when the gas was of highest illuminating power, and the volume of gas small, the tars would be largest in quantity and extremely rich in condensable vapours; for the illuminating power of the gas and the quality of the tars condensing from it bear a definite relation to each other—gas rich in illuminants, when condensed, depositing tars rich in illuminating vapours.

To render these illuminating vapours directly valuable to the gas manufacturer, it is necessary to bring gas in contact with them to take them up in diffusion; and one method adopted to get this gas is to use a higher temperature in the carbonization of the oil. But as this gas is obtained to a large extent by the cracking-up of what at the lower temperature would go to form the denser part of the tars, and as not only gas, but also certain quantities of volatile illuminating vapours, are produced, the loss is more than balanced by the gross gain. As the temperature of carbonization rises higher, however, the denser portions of the tar become more stable, and are not so readily cracked-up into gas; and the illuminating vapours are themselves cracked-up to a greater extent, until a temperature is reached when the volume of gas produced exceeds that required to take up the illuminating vapour simultaneously produced in diffusion, when the gross illuminating power of the gas obtained from the oil is diminished.

When carbonizing oil by itself, or shale or cannel by themselves, for the production of gas, it is therefore evident that the best temperature to employ is that which cracks-up the constituents of the oil, shale, or cannel, in such a manner that there is produced a balance between volume of gas and the illuminating hydrocarbon vapours that can

be taken up in diffusion through the gas. These facts are very clearly demonstrated by the results obtained from a series of experiments made by Mr. Pryce, under the direction of Mr. Hunt, at the Windsor Street Gas-Works, Birmingham, and published in the "Transactions" of the Institution of Gas Engineers for the year 1892.

The following is an extract from the tabulated results given :—

—	Russian Oils.							Shale Oils.			
	A. Lustre.				B. Solar Distillate.			C. As supplied to Rail. and Tram. Companies.		D. Obtained Direct.	
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(1)	(2)	(1)	(2)
Mean temperature of retort	1177	1410	1570	1592	1380	1445	1690	1521	1628	1447	1630
Gas produced in cubic feet per gallon of oil	44·3	74·5	101·3	117·1	58·0	82·9	120·3	82·5	94·6	66·6	83·1
Illuminating power	30·8	49·6	35 7	25·0	58·0	48·2	22·0	41 2	34·3	62·9	46·3
Multiple	1364	3695	3616	2927	3364	3996	2646	3399	3245	4189	3847
Condensed liquid products (fluid ounces per gallon)	89·5	26·5	4·1	0·5	52·4	65·5	0·5	32·2	9·5	43·2	16·2

Mr. Pryce remarks, regarding the above table: "It would appear from these experiments that at a particular temperature the oils give the best results. At temperatures below this, the value of the gas falls off, and, notwithstanding the increased volume at higher temperatures, the value is also less."

The conditions are very different when the volume of gas is supplied from a source outside the oil or the cannel. It is then no longer necessary to crack-up a portion of the oil or cannel to produce volume; the object being to produce the maximum possible quantity of hydrocarbons capable of enriching the volume of gas from outside sources. The temperature at which it is necessary to carbonize the oil or cannel to produce this latter result of maximum enrichment value, is very much lower than that required to produce the maximum illuminating value from the oil or cannel carbonized alone. The maximum illuminating value is obtained from the oil or cannel when the temperature of carbonization reaches the point at which the multiple of volume of gas and the illuminating power of the gas are at the maximum. The largest enrichment value obtainable from the oil carbonized by itself to produce the maximum of illuminating value to be thereafter mixed with coal gas, is from 900 to 1000 candles per gallon of oil. On the other hand, when the oils are carbonized at a lower temperature, so as to produce the maximum quantity of enriching hydrocarbons, and the gas to be enriched brought into contact with these enriching hydrocarbons, there may be obtained an enriching value of 1400 to 1600 candles per gallon of oil.

When the oily products obtained from the carbonizing of bituminous gas coals are cracked-up, at gradually increasing temperatures, results very similar to those got from the shale oils are obtained at first—that is, at the lower temperatures. But owing to the much smaller quantity of paraffins and olefines, in proportion to the other hydrocarbons present in these oily products from the coal, and from the different manner in which these other hydrocarbons crack-up, the gas obtained is at no temperature of the same illuminating power as that got from the cannel or shale oils; and the maximum illuminating power is reached before the paraffins present in the oily products have all been cracked-up. On the other hand, however, the illuminating power of the gas does not fall away so quickly with increased temperatures of carbonization as is the case with cannel or shale oils; and the gross illuminating value continues to rise. It is only when the temperatures are so high as to begin to crack-up the highly stable benzol, that the gross illuminating value falls away.

The temperature which is necessary to carbonize gas coals, to produce volume of gas combined with the gross illuminating value, is therefore very much higher than that suitable to carbonize cannel, to obtain from it the maximum of enriching hydrocarbons. It is therefore evident that, to carbonize cannel at those high heats, a large part of the enriching value must be lost; and therefore the convenience of carbonizing both together at the higher heat involves very considerable loss of enriching products.

The next point to consider is the method of bringing the large volume of gas from the coal and the enriching hydrocarbons from the oil or cannel into contact, as the manner in which this is effected has a considerable influence both upon the enrichment obtained and upon the removal of the naphthalene.

By the usual method of using cannel—carbonizing it along with, or at least at about the same temperature as, the coals—the cannel is not only over-cracked-up, but the resulting over-decomposed products are passed into, and mixed with, the whole of the products from the bituminous coal. The bituminous coal products contain large quantities of naphthalene, and also oils having a powerful solvent affinity for the volatile illuminating hydrocarbons—each 10,000 to 11,000 cubic feet of bituminous coal gas being accompanied by from 10 to 14 lbs. of the former and from 60 to 80 lbs. of the latter. During the process of condensation, the illuminating volatile vapours present in the products from the cannel are necessarily more or less subjected to the solvent influence of the coal tar, by which some of the illuminating vapours are absorbed; and the enormous quantity of naphthalene is sufficient to practically saturate the liquid tars from both cannel and bituminous coals, unless the proportion of cannel is very large. It is thus seen that, by the usual method of using the cannel, its full enrichment value is not obtained. The temperature at which it is carbonized is much higher than that necessary to produce the maximum yield of products capable of enriching the large volume of bituminous gases; and the condensed tars from the cannel are less able to act as solvents for the naphthalene. Both these losses are still further increased during the process of condensation, in the manner to which reference has just been made.

By carbonizing the cannel separately, the temperature best suited to the particular cannel used can be adjusted to produce the higher yield of enrichment; and by separately condensing the products out of the gas produced from the bituminous coal carbonized at high temperatures, the accompanying naphthalene and solvent oils are nearly all removed—not one-hundredth part of the naphthalene being left in diffusion in the gas. On bringing the gas so purified from condensable products into intimate contact with the products from the cannel carbonized at the lower temperature, the gases are free to take up their full load of carburetting hydrocarbons present in the cannel products; and the denser hydrocarbons from the cannel, being practically free from naphthalene themselves, form excellent solvents for the naphthalene still present after condensation in the large volume of high-temperature gases.

The great advantage to be derived from the separate carbonization of the coal to produce volume, and of the cannel to produce enrichment, and the separate condensation of the high-temperature gases and their subsequent contact and treatment with the cannel products, are thus fairly evident.

It gives me peculiar pleasure, in concluding this paper, to draw attention to some statements made by the late Mr. John Methven, in 1892, which, looked at from the standpoint of our late experiences, seem to have been quite prophetic—

I have made some experiments on the subject dealt with by the papers we have heard this afternoon, which have convinced me that it is absolutely necessary, before we can get an economical result, to have a proper and effectual conveyor for the oils when they are cracked-up. My first experiments were made by mixing different oils with coal in an experimental retort; and I was very much disappointed with the low result of illuminating power which I obtained from that process. Repeated experiments eventually convinced me that there was some mischievous operation going on in the hydraulic main—that one of the hydrocarbons (possibly a heavier one) laid hold of the lighter ones which came off from the oil, and consequently absorbed the light-giving properties of the mixture. I extended my experiments, with the view of forming a conveyor or carrier for these hydrocarbons. Oil was injected into the retort by means of superheated steam; the oil gas

and coal gas being made alternately and mixed in the holder. These experiments gave better results than the first series. But still they were unsatisfactory; some of the hydrocarbons or light-giving material being lost. The next set of experiments I conducted were by passing purified coal gas into the ascension-pipe of the retort in which the oil was being carbonized or cracked-up. I may say that this series of experiments gave very much the best results. At first, we put the purified gas into the retort itself; but we found a decided loss took place from the action of the heated iron of the retort on the gas, so that plan was abandoned. Next, we conveyed a measured quantity of coal gas of known illuminating power into the ascension-pipe, where it met the vapours coming off from the oil; and I must say that the experiment gave results which were extremely satisfactory. I was hopeful of being able to try the experiment on a large scale before this meeting, and that I should have had some figures to lay before the members. But on some future occasion I hope to be able to do so. I cannot help thinking that this is the direction in which we must look for the economical use of oil as an enricher. There must be a conveyer for it. If we crack it up and put it with the gas in the hydraulic main, the heavy hydrocarbons in the uncondensed gas—the tar, and so forth—absorb the light-giving properties of the oil, a great deal of which is thus lost; but by providing at once a suitable conveyor, freed from absorbent hydrocarbons, a permanent gas can be made with very economical results.

The results obtained at St. Helens throughout the last two-and-a-half years' continuous working with cannel carbonized at suitable temperatures in separate retorts, and mixed as described in the paper communicated by my brother and myself in 1898, have enabled us to enrich our gas (the bulk of which is made from the cheapest quality of coal) in the most economical and satisfactory manner.

I desire to acknowledge the help of my friend Mr. William Young, of Peebles, in the investigation of this subject. He has guided me with his extensive and varied experience, in my search for a natural remedy for naphthalene troubles. In adopting the lower temperature for carbonizing cannel, we expected to get some amount of additional enrichment, as well as obtain solvents and carriers for naphthalene. The working results have more than realized our highest expectations; and I hope to have the pleasure of submitting some further experiences upon another occasion.

Discussion.

Mr. F. W. Stevenson (London) said the question of gas enrichment was of peculiar interest at present; and he was sure they must all feel grateful to those who investigated it in the manner which Mr. Glover had done. Any remarks that he might make, he hoped Mr. Glover would feel were not due to want of appreciation of his work in any way whatever; and if he agreed with him or not, it was simply because, in trying his process, the results he had obtained had not accorded with the statements made in the paper. He was fascinated with Mr. Glover's process when it first came out, because it was to give them the means of increasing enrichment with the same materials heretofore used. Then there was the very important point of the relief to be obtained from naphthalene troubles, which Mr. Glover had found in his own case. This being so, after consultation with Mr. Glover, and obtaining his permission to try the process at Sheffield, it was decided to make experiments at the Effingham Street works of the Company. The works were very suitable for the purpose, because from May to October each year one-quarter of the retorts were in operation continuously; so that there would be no disturbing influences to interfere with the experiments. These were made on eleven beds of eight through retorts, 21 in. by 15 in., making about a million cubic feet of gas per diem. He had tabulated the results, and would give an epitome of them. First, a twelve days' trial was made with the retorts working in the ordinary way; and 1215 tons of South Yorkshire coal and Nottingham and Derby cannel were carbonized. Of this, 20·82 per cent. was cannel; and the average illuminating power was 17·72 candles, with a make of 10,327 cubic feet of gas per ton. Then a twelve days' trial was made with Mr. Glover's process; and 1231 tons of coal and cannel were carbonized, 18·84 per cent. of which was cannel. From this, 10,337 cubic feet of gas per ton was obtained, with an illuminating power of 17·80 candles. At that time, Mr. Glover came over to Sheffield and saw the arrangements, and expressed himself as fairly satisfied with them. But he suggested that the temperature of the cannel retorts should be reduced, which was done, and the heats maintained at about 1400° Fahr. Into the cannel retorts, 3-cwt. charges were put, and run for about eight hours. After a slight alteration had been made, there was a further run of eight days without Mr. Glover's process. During this period 874 tons were carbonized, 20·48 per cent. being cannel; and 10,115 cubic feet of gas per ton was made, with an illuminating power of 17·73 candles. On an eight days' trial again, with Mr. Glover's process, very nearly the same results were obtained—837 tons were carbonized, of which 20·55 per cent. was cannel; 10,179 cubic feet of gas per ton was made, with an illuminating power of 17·63 candles. He should say that the whole of the cannel was not carbonized in the two beds. From 76 to 80 per cent. of the cannel was carbonized in the low-temperature retorts. After further trifling alterations, suggested by Mr. Glover and by his own experience, they went on continuous work. From June 13 to Sept. 4, they had 80 days' work with the process; and this, he thought, was a pretty fair trial. There was no alteration in the number of retorts; and each week there was an even quantity of coal and cannel carbonized—720 tons. The total was 8640 tons, and the percentage of cannel 19·12. The yield of gas per ton was 10,570 cubic feet; and the illuminating power was 18·04 candles. The yield was not exceptional for that time of year, when the work was going on continuously, and there was nothing unusual about the make. It might be interesting to know the average temperatures of the gas and atmosphere during the run. The coal gas was condensed, before any mixture with cannel gas, to 66° Fahr.; the average temperature of the cannel gas before mixture with coal gas was 138°; and the temperature of the mixed gases at the outlet of the condensers was 80°. The average temperature of the cannel retorts was 1400°, and the atmospheric temperature 67°. From these figures, there was nothing very special to show that the process was a success. Practically, he could not say there was any advantage in enrichment, because it was just about the usual average at these works. Then came the more important point of naphthalene. When they commenced the process, the complaints of stoppages in the district supplied from the works were about three a week; and they rose to 84 per week. It might be said that there were old deposits in the mains; but again and again he tried to detect naphthalene in the mains during the winter months, and he could never find any up to about eighteen months ago. He himself thought that the naphthalene was formed in the early spring, while this process was at work. The complaints, as he had said, rose to 84 per week; and as the process had been put in chiefly for the purpose of reducing naphthalene, they discontinued it. He did not believe that it increased the naphthalene complaints, because the other works were subject to about the same increase. For the remainder of that summer, little more was done. In the autumn he had an interview with Mr. Young, of Peebles; and he came to the conclusion that the difference between St. Helens and Sheffield was chiefly that at St. Helens they had horizontal condensers, and that the low-temperature gas mixed with the cannel gas near the inlet of the condensers. The gases travelled together through the condensers, and so a thoroughly good mixture was obtained. At Sheffield, the gases met one-third of the way through the vertical condensers; and the liquid products went into the tar-well at once. It was then suggested that they should construct a washer in which the proper mixture could be made; and he hoped to do this in the following summer. But he did not get the necessary permission; and he had to fall back on experimental work. They then made some trials at the experimental works with small cast-iron retorts taking 1¼-cwt. charges. Their first trial was a mixture of 80 per cent. coal and 20 per cent. cannel, working in the ordinary way. The coal and cannel were charged in separate retorts, which were all kept at a sharp heat; and the gas mixed in the hydraulic main. The average result of sixteen tests, of 4 or 5 cwt. each, was a yield of 11,116 cubic feet per ton, with an illuminating power of 17·93 candles, and 683 lbs. of sperm. This certainly did not bear out Mr. Glover's contention that a proper result in enrichment could not be obtained by mixing the coal and cannel, and carbonizing together at a high heat. They then made a further test in the same way; the only difference being that in the first test the gas was not washed. It passed direct from the condensers to the purifiers without washing; while in the second case, the gas was washed in a Livesey washer. The average result again of sixteen tests was a yield of 10,941 cubic feet per ton, an illuminating power of 17·73 candles, and 665 lbs. of sperm. In the next sixteen tests with Mr. Glover's process, the gas and liquid products mixed with the coal gas at the inlet to a Livesey washer; and the average make was 9976 cubic feet per ton, the illuminating power 18·83 candles, and the sperm result 644 lbs. This was very disappointing to him; and they

then made a special washer designed to effect intimate contact and mixture—thinking that the Livesey washer might not be effective. The average result of the tests with the special washer was a make of 10,152 cubic feet of gas per ton, an illuminating power of 18·30 candles, and 637 lbs. of sperm. Then they kept the temperature of the special washer at 130° Fahr., and obtained an average result of 10,359 cubic feet per ton, an illuminating power of 18·44 candles, and 654 lbs. of sperm. This was the result of his experiments. He was extremely disappointed with them. Of course, he might be wrong. Others might try it, and get different results; and he gave them his figures for what they were worth. It was not in any hostility to Mr. Glover that he had given these figures; but having obtained certain results, he could not withhold them from the members.

Mr. T. Holgate (Halifax) said he rose at the request of the President; but he had had no experience of Mr. Glover's process. He remembered that many years ago a somewhat similar suggestion was made under the name of Dr. Eveleigh's system. That gentleman proposed to carbonize cannel at a low temperature, and to use the low-temperature products for the enriching of gas produced from coal in high-temperature retorts. He (Mr. Holgate) believed the process failed because of the relatively small quantity of gas produced from the plant employed. In other words, the low-temperature retorts did so much less work than high-temperature retorts would have done; and, secondly, the labour in gas making and capital expenditure were both increased. He should have been pleased if Mr. Glover had given some description of the process itself, and the plant required in proportion to ordinary methods, as well as some figures as to working results. This information would form a desirable addition to the paper.

Mr. A. F. Browne (London) said he would like to ask one question with regard to this very interesting paper, which appeared to divide itself into two parts, which had just been discussed from a practical point of view by Mr. Stevenson. The paper itself put the matter in a very attractive light; and Mr. Stevenson admitted that he had been very much captivated with the process at the outset. He (Mr. Browne), for one, was also much disappointed that, on trial, the process had not been so successful as could have been wished. With regard to the purpose which the process was intended to effect in the removal of naphthalene, it appeared to him that its object would conflict with the purpose of using it as an enricher. As in the process which they had previously been discussing, the cost went up very rapidly with the temperature. It was evident that, during a great part of the year, it was impossible to keep the temperature of the gas down to as low a figure even as 60°; and this might even be a somewhat low temperature at some gas-works during the greater part of the year. The broad fact was that, as the temperature increased, the cost of the washing process which Mr. Irwin spoke about increased rapidly; and it appeared to him that this would be the case also in Mr. Glover's plant. And not only would it be so, but this curious condition of things made its appearance, that as the temperature went up, and the quantity of naphthalene to be removed by the process increased, so did the percentage of cannel increase. But that was just the time of the year when the percentage of cannel should go down. So that the object of the process in the removal of naphthalene, seemed to conflict with its object as an enricher of gas. It also appeared—though this was not apparent from the paper—that some modification of condensing plant might be requisite, in order to get the full advantage of the process for the removal of naphthalene. He would like to ask Mr. Glover how he got over the difficulty of being obliged to use more cannel than was required for the enrichment of the gas, for the purpose of removing the naphthalene.

Mr. S. Meunier (Stockport) said one point which was brought home to him rather seriously in his early days at Stockport, was the advisability of carbonizing coal and cannel in separate retorts. It appeared to him that, when he first went there in 1891, the percentage of cannel used was very large; and the coal which came into the works was mixed up with the cannel, and was carbonized in the same retorts. As they decreased the cannel, and increased the quantity of the coal, he found every time they mixed the two together they got less good results. The quantity of gas made was very much less than when they turned round and carbonized each in separate retorts. They had never taken particular notice of the temperatures of the retorts in which they used cannel; but, as a rule—and this might have some little bearing on the author's statement—the cannel was put in the bottom retorts, which were of rather lower temperature than the others. They undoubtedly obtained better results all round by keeping the coal and cannel in separate retorts for carbonization.

Mr. T. May (Richmond) said they had heard what was the result at Sheffield; and Mr. Glover had told them in general terms what happened at St. Helens. If Mr. Glover could state what was the comparative result of working with his process and working in the ordinary way, he would give them some basis on which to judge the system.

Mr. R. Beynon (Torquay) said it struck him, in thinking over the subject, that the quality of the coal used might have made a difference. Mr. Glover would employ Lancashire coals and cannels, and Mr. Stevenson would use Yorkshire. This might account for the different results.

Mr. W. Foulis (Glasgow) said the process was contrary to all their experience in carbonizing cannels and shales, as with these it was usually supposed that high heats were required. In his opinion a great deal depended, in the case of high-quality gas, upon getting the gas out of the retorts as quickly as possible, and not letting it hang about and so get decomposed. The discrepancies they had heard about might be accounted for in this way; and it would be well to know the duration and weight of the charge, and all that sort of thing, before giving any expression of opinion upon the process described in the paper.

The President said he did not think Mr. Glover would be disappointed because the discussion had not been as lengthy as it might have been. There had been a certain amount of overlapping in the paper he had read and that which immediately preceded it. There was, in his opinion, a good deal in what Professor Lewes had said that morning—that the question of carbonization of coal had received very scant consideration at the hands of engineers during past years. He was certain now, from what he said, and from information that they had received from Mr. Glover and others, that this subject would, in the immediate future, receive far more consideration than it had in the past. If only for this reason, he thought Mr. Glover's paper was one of the utmost importance. It was always well in a discussion that diverse opinions should be expressed. Simply because a gentleman read a paper, he must not expect everyone to agree with him. Local circumstances must be taken into consideration. It seemed, perhaps, rather remarkable that the experiments carried out by Mr. Stevenson should be so absolutely at variance with the experiences of Mr. Glover, because the local circumstances should not be so very greatly different between St. Helens and Sheffield. But still it did appear that they were very different. It struck him that Mr. Stevenson tackled the subject more with the idea of getting enrichment; while he (the President) understood the invention was to do away with the naphthalene trouble. There was great diversity of opinion on the question of how high-class coals should be cracked-up. It was a pity Mr. Glover was not able to give particulars of the cost of working out the process. But perhaps he did not care to put all his goods in the shop window. He had promised to give them other results on some future occasion. They would all look forward to these results with a great deal of pleasurable anticipation.

Mr. Glover, in reply, said he was not at all disappointed with the spirit of the discussion. What he was disappointed in was that members of the Institution failed to grasp the possibility that, by treating the same coals or shales in an entirely different manner, entirely different results would be obtained. It was disappointing to him that, after such a lecture as they had had that morning, in a meeting of engineers and members of a technical Institution, there should be such a want of appreciation of the possibility of different results being obtained when a process for obtaining such results was properly worked. With regard to the remarks of Mr. Foulis, if he had treated his shales in an entirely different manner, he might have got an entirely different group of hydrocarbons, which would have been much more useful to him in making the high illuminating power gas which he was called upon to supply in Glasgow. Mr. Stevenson started to say he had *worked* the process; but he subsequently altered this assertion by saying that he had *tried* it. If he had persisted in saying he had worked the process, he

(Mr. Glover) should reply that he never worked it properly. Mr. Stevenson mentioned his (Mr. Glover's) visit to Sheffield, and said he expressed himself as fairly satisfied with the arrangement. It certainly had been put together in a cheap and suitable sort of way; and there was no reason why he (Mr. Stevenson) should not get good results, if he worked it in a proper manner. At the same time, it was pointed out that the heat of the cannel retorts was altogether too high, and that the results were not likely to be good, because Mr. Stevenson brought the hot cannel products and mixed them with the coal gas, and immediately plunged them into vertical water-tube condensers, in which the mixing of these products had no chance whatever of taking place. The experiments contradicted themselves. The process was developed to serve two distinct purposes; and in finding solvents for naphthalene from coals differently carbonized, they also found a larger increase of enrichment than they expected. The process was fully described two years ago, when the proportion of cannel required was reduced to one-half of what it was when it was carbonized in the same retorts as coal. The process had been continued. The fuel was made from the lowest and cheapest quality of coal, and was enriched to 18½ to 19 candles by 10 per cent. of the cheapest local quality of cannel. He was quite sure he should never have thought of bringing before the members any assertion of what he had been getting without having good results; and those were the good results of works producing upwards of 300 million feet of gas.

SOME EXAMPLES OF TANK CONSTRUCTION.

By F. W. Stevenson, of London.

As the title of this paper indicates, it is not intended to deal with the subject of tank construction generally, but it is proposed to give examples which have occurred in the course of the author's work while constructing new works at the Grimesthorpe station of the Sheffield Gas Company.

The first is that of a gasholder tank originally intended to be 156 feet in diameter. The construction of this tank was commenced in the year 1867, and proceeded as far as building the wall and excavation of the dumpling. It was then found that the tank had tilted bodily, being 20 inches lower on one side than the other. It was then abandoned for many years.

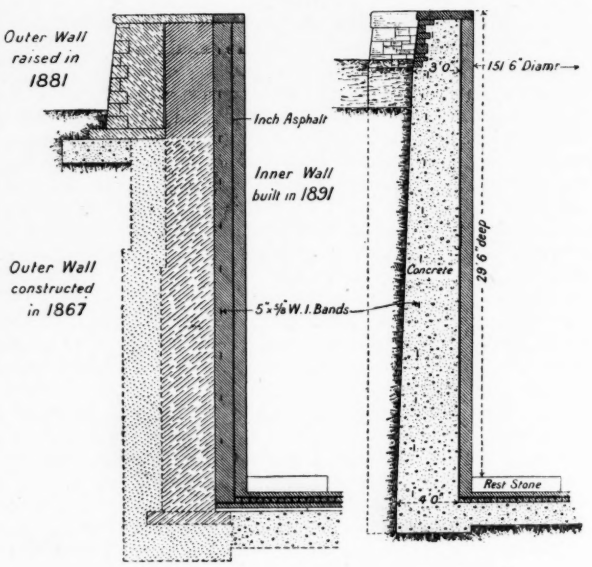
The cause of subsidence was due to colliery workings, which, if not in operation exactly underneath, were in very close proximity; while the particular direction of the settlement was no doubt due to the high dip of the sub-strata of about 1 in 2½, caused by the well-known great fault of the Don Valley, which extends for some miles on the north side of the river upon which the tank was constructed.

In the year 1881, the collieries having ceased operations, and the workings and pit-shaft filled with water to within about 12 feet of the surface, the author's predecessor took in hand the completion of the tank. The section of the wall, as designed and carried out by him, is shown in fig. 1. By this, it will be seen that the coping was raised 6 feet above the ground level; and to obtain the necessary strength, the original wall, which terminated 3 feet thick at ground level, was outbuilt just below the ground to make it 7 feet thick—terminating below the coping at 6 ft. 3 in. thick. An open vertical joint of 1 inch was left between the original wall and the outbuilt portion, but was grouted up before the coping was set; thus practically making the upper wall solid. The bottom of the tank was laid with concrete, and the whole carefully rendered with portland cement.

It was then filled with water to within 3 ft. 6 in. of the curb, when cracks appeared in the wall, and the water escaped faster than it could be put in; and though repeated attempts were made by caulking to stop the cracks, they invariably opened again when the water reached the 3 ft. 6 in. limit. Unquestionably, the outbuilt portion of the wall at the top, instead of being the source of strength for which it was intended, became a serious source of weakness, as by settlement on the comparatively soft ground outside, its weight tended to split the tank-wall, which it effected when assisted by the weight of water within.

For another ten years the completion of the tank stood in abeyance, until in 1891, when additional storage became a necessity, it was decided to make a third attempt. Careful levelling having shown that settlement, if any had taken place in the ten years, was infinitesimal, the author came to the conclusion that the only plan was to build an inner wall of sufficient strength to resist the outward pressure. At the same time, it was expected that considerable support would be obtained from the existing wall after so many years had elapsed for consolidation. Mr. George Livesey was then called in to advise; and he supported the view already taken by the author to build an inner wall. At the same time, he recommended the use of asphalt on account of its elasticity, instead of cement rendering.

Examples of Tank Construction. Sheffield United Gas Company.



Figs. 1 & 2. Fig. 3.

The use of asphalt was not, of course, original; Mr. King, of Liverpool, having adopted it in a large gasholder tank there, the construction of which he described in a paper read before the Gas Institute in 1874. Mr. King kindly furnished the author with a sketch showing the method he used in applying the asphalt; and this was adopted at Sheffield. Messrs. T. Atkin and Sons, of Liverpool, who executed the asphalt work for Mr. King, were entrusted with it also at Sheffield.

A section of the lining wall is given in fig. 2. It consists of two vertical walls with a 1-inch cavity between for the asphalt. The back wall was built close up to the inner face of the existing tank; the thickness varying very much as the original tank wall was much out of plumb, but it averaged 14 inches. It was kept as the work proceeded a few courses higher than the inner wall, which was 9 inches thick. Hot asphalt was run into the cavity at every two courses in height. Continuous wrought-iron hoops 5 inches by ⅝ inch, placed on edge, were built into the back wall at every 2 ft. 6 in. apart. The bottom was laid as shown, with two courses of brick flat, with open joints, and two layers of asphalt, each 1 inch thick. In the other tanks, one layer only of asphalt 1 inch thick was used. The result of this construction was most satisfactory, as, on testing, the tank proved bottle-tight; and this has been the experience of the author in every tank in which this asphalt was used.

The second example is that of a gasholder tank constructed alongside the first. Inside dimensions were the same in both cases—namely, 151 ft. 6 in. diameter by 29 ft. 6 in. deep to rest stones. A section of the wall of the second tank is given in fig. 3. A circular trench was excavated in the usual way, and the outer wall put in composed of 8 to 1 portland cement concrete. This wall was 4 feet thick at the bottom, diminishing to 3 feet thick at the top, with 18 column piers each 6 feet square. The curb was raised 6 feet above the existing ground level; the latter being afterwards made up 3 feet, and the exposed portion of the wall faced with random-course stone. Wrought-iron hoops, 5 inches by ⅝ inch, were inserted in the concrete wall every 3 feet in height. The concrete wall being constructed, the dumpling was excavated and the inner 9-inch brick wall, with asphalt lining at back, and the bottom were proceeded with. The Lewis stones for guide-rails were built into the 9-inch lining wall, so that throughout the envelope of asphalt was unbroken.

The cost of this tank and framing for supporting the gasholder crown, was as follows:—

	Totals.		Per 1000 Cubic Feet of Tank Capacity
Tank	£8564	..	£15 17 9
Framing	592	..	1 2 0
	£9156	..	£16 19 9

Being £5 4s. 8d. per 1000 cubic feet of gasholder capacity.

The capacity of the tank, taking the area by depth to the rest-stones, is 539,000 cubic feet. The gasholder was one with four lifts, of a capacity of 1¾ million cubic feet. An epitome of the schedule of quantities, with cost, is given in Appendix A.

The third and last example is that of twin tar and liquor tanks; the tar-tank being 50 feet by 50 feet, and the liquor tank 100 feet by 50 feet, and both 20 ft. 6 in. working depth. In constructing these, the trenches were first excavated for the three main outer walls, which were then constructed of concrete of the same description as was used for the gasholder tanks. When the inside of the tanks were excavated, the side walls presented an unbroken face 158 feet long by 24 feet deep, so that on the side on which the great thrust had to be borne from the dip of the subsoil, the wall was made exceptionally strong—being 5 feet thick at the bottom, diminishing to 3 feet at the top. On the other side, the wall was made 3 ft. 6 in. thick at the bottom and 2 ft. 6 in. at the top; the end wall being 2 ft. 6 in. thick throughout. The usual open-jointed drain-pipe was laid around the outside of the tank, to a sump from which an ordinary contractor's hand-pump was sufficient to keep the water down.

In this case, the 9-inch internal wall was strengthened by building piers at 10-feet centres, 18 inches long, and projecting 9 inches. At the same time that the lining wall was built, two division walls were also built—one to divide the larger and smaller tanks, and the other at the end of the larger one to provide for another tank when required. These divisions were each made of two walls 18 inches thick, with piers similar to the side walls, and having a cavity for asphalt between. The roof was constructed of a three-half-brick ring-arch, carried on cast-iron girders, and supported by cast-iron columns, placed 10 feet centres longitudinally by 6 ft. 4 in. transversely. The whole was sufficiently strong to allow a locomotive and loaded coke-trucks to pass over. A large cast-iron shaft, 3 feet in diameter and rising 15 feet above ground, was provided for the ventilation of each tank. The working capacity of the two tanks is 960,000 gallons; and the total cost was £6668, or £6 18s. per 1000 gallons. An epitome of the schedule of quantities, with cost, is given in Appendix B.

The asphalt employed in these examples was prepared from pitch which contained a portion of the heavy tar oils; the distillation of the tar having been stopped at a lower temperature than is usual with tar distillers. Natural rock asphalt consists of soft limestone impregnated with bitumen; and as this soft limestone cannot be obtained for the artificial asphalt, finely ground soft chalk is mixed with the comparatively soft pitch. This, when required for use, is melted and raised to a high temperature, and a considerable proportion of fine dry sand mixed with it.

Two instances which occurred during the construction of the tanks may be mentioned as illustrating the remarkable elasticity of the asphalt. The first occurred while the concrete wall of No. 2 gasholder tank was being put in—No. 1 being empty at the time—preparatory to the erection of timber framing for the gasholder crown. A thunderstorm, accompanied by heavy rain, caused the water to flood back through the main sewer into the sump adjoining, and drowned out the pumps; the water rising some 6 feet high. This lifted a portion of the floor in No. 1 tank about 12 inches over an area of 10 or 12 feet square. On clearing away the top course of bricks, it was found that the asphalt was not fractured; but to provide escape for the water underneath, and prevent further damage, the asphalt was pierced with a bar, when, instead of water, imprisoned air escaped with a whistling sound, and in two hours time the asphalt had settled down to its original position.

The second was of a similar nature, and occurred to the tar and liquor tank. It had been specified that when the bottom of the tank was complete and the whole of the iron-work on which the brick arches were to be turned had been erected, the pumping from the outside sump might be discontinued. On the pumps being stopped, the water rose about 3 feet above the level of the tank bottom; and it was found that the whole of the bottom of the larger tank had lifted, raising with it the concrete layer 12 inches thick, the base-stones of the columns, and the whole of the roof iron-work—altogether a weight of about 412 tons. The lifting was in the form of a bow springing from the sides, and having

Appendix A.

Epitome of Priced Schedule of Quantities of Gasholder Tank, 151 ft. 6 in. Diameter by 29 ft. 6 in. Deep, to Rest-Stones.

Quantities.	Description of Work.	Rate.	Amount.
		s. d.	£ s. d.
Cub. Yds. 18,000	Excavation	1 11	1724 0 0
	Drain-pipes laid round tank to sump	..	72 0 0
	Use of timber for shoring	..	20 0 0
3645	Concrete—8 to 1 portland cement	15 3¾	2790 7 8
Sup. Yds. 4200	One course brick flat over bottom	2 2	457 0 0
1600	One brick thick lining in wall	6 0	480 0 0
Cub. Ft. 1748	Ashlar stone, including all labour for dressing, sinking, and setting	3 9½	331 10 9
Sup. Yds. 188	Rock-faced wall stone outside tank above ground level	4 0	37 10 0
Cwt. 1056	In wrought-iron tank guides, hoops, and holding-down bolts, &c., including all labour for fixing	12 0½	635 6 3
Sup. Yds. 3826	Asphalt 1 inch thick	4 6	861 0 0
	Cartage of spoil from excavation to tip (about ¾ mile distant)	..	600 0 0
	30-inch diam. inlet and outlet pipes, including all labour for fixing	..	300 0 0
	Pumping and sundries	..	254 18 2
			8563 12 10
	Framing to Support Gasholder Crown.		
Cwt. Qrs. 1175 3	In castings for standards and heads for junction of rafters, including erection	7 1	415 14 4
60 1	In wrought-iron tie-rods, plates, &c., including erection	19 1	57 8 0
Cub. Ft. 934	In timber for framing, including all labour for cutting and fixing	2 6½	119 10 2
	Cost of framing	..	592 12 6
	Cost of tank	..	8563 12 10
	Total	..	9156 5 4

Appendix B.

Epitome of Priced Schedule of Quantities of Tar and Liquor Tanks, 150 feet Long by 50 feet Wide and 20 ft. 6 in. Deep = 960,000 gallons capacity.

Quantities.	Description of Work.	Rate.	Amount.
		£ s. d.	£ s. d.
Cub. Yds. 9300	Excavation, including use of timber for shoring	0 2 1	970 0 0
	Timber frames and moulds for concrete	..	63 0 0
Lin. Ft. 524	Drain-pipes laid round tank to sump	0 1 6	39 12 6
	Pumping	..	80 0 0
Cub. Yds. 1983	Cement concrete (as before)	0 15 4½	1522 3 3
Sup. Yds. 2630	Brickwork in cement mortar reduced to one brick length, including all cutting, &c.	0 5 3¾	698 19 0
905	Segmental arches in three half-brick rings in cement mortar, including all cutting, &c., and centres	0 9 2¾	417 15 9
Cub. Ft. 569	Stone in padstones, base-stones, and kerbs, &c., with all labour	0 4 7	130 7 0
Tons 172½	In cast-iron columns and girders, manhole frames, &c., including painting and erecting	6 11 1	1130 12 0
3¾	In wrought-iron tie-rods, bolts, &c., including painting and erecting	22 15 8½	85 9 6
Sup. Yds. 2124	Asphalte 1 inch thick	0 4 10	513 6 0
	Carting surplus spoil to tip (about ¾ mile distant)	..	914 0 3
	Tar and liquor pipe connections	..	50 0 0
	Sundry items	..	51 18 8
			£6667 3 11

Note.—All labour and extra items of charge are added to amounts for description of work to which they apply, and from this the rate is calculated to the nearest farthing.

a rise in the centre of about 10 inches. The pump being set to work again, and the water lowered, the whole weight gradually settled back to its original position, without causing any fracture of the asphalt.

The cost of the asphalt and lining to maintain it in position is, of course, more than that of clay puddle, and considerably more than cement rendering; and the author does not by any means recommend its universal application. The duty of the engineer is clearly to make use of local material, when such is suitable for his work. But at Sheffield clay suitable for puddle cannot be procured in the neighbourhood; and with the peculiar stratification of the subsoil in this particular district, and where slight movement might take place, the author is convinced that sooner or later trouble would have arisen with cement rendering. Moreover, rendered tanks, though easy to make water-tight at first, will often give trouble when they come to be emptied for renewal of the gasholder, after a length of years. At any rate, such has been the author's experience with rendered tanks at Sheffield.

In conclusion, it may be said that the use of this asphalt is not confined to tanks. It is equally suitable for flat roofs, wet basements of buildings, or floors on which wet processes are in operation.

Discussion.

Mr. T. Holgate (Halifax) thought they should express their thanks to Mr. Stevenson for his lucid description of the work carried out, and for the completeness with which he had drawn up the appendices. From these schedules of prices and quantities, each engineer would be able to calculate for himself the relative cost of the asphalt method as against cement rendering. Mr. Stevenson had stated in the paper that rendered tanks which had remained tight while in use had become leaky after exposure to the air. He (Mr. Holgate) had wondered, while hearing the paper, what was the cause of leakage—whether it was some disintegration of the surface of the cement which had taken place while exposed to the air.

Mr. P. H. Fletcher (Evesham) said he would like to ask Mr. Stevenson if the asphalt would not hold itself on the wall without an inside lining.

The President said Mr. Stevenson had given them the paper as the result of his experience. It was more a paper of reference than anything else; and the members would read it again when they had anything to do with tank construction. They had all found difficulty in making water-tight tanks. He remembered some time ago he wanted to make a retaining wall water-tight; and put in asphalt between two brick walls; but it was not a success.

Mr. Stevenson, in reply, said he had not expected a very animated discussion on the paper; but it might be useful to the members at some future period. He was unfortunate in having at Sheffield two gasholder tanks, which had been rendered, leaking. Perhaps at Sheffield the atmosphere and the acidity of the air would account for it. There were very many cases of water-works tanks having been constructed with asphalt plastered on the face. Such construction would hardly be suitable for gasholder tanks, because the asphalt would be liable to be damaged by the ironwork, during erection, bruising the asphalt, and thus forming leakages. Whether the asphalt was affected by tar, he had not made experiments to show; but the makers themselves, who had done an enormous amount of work in this way at Liverpool, had lined with it their own store-tanks, which he understood were put down thirty or forty years ago, and were perfectly sound to-day.

AN EXPERIMENT WITH A CONCRETE AND EXPANDED METAL STRUCTURE.

By A. Baker, of Beckton.

Although expanded metal is now so extensively used by engineers and builders generally, the gas profession apparently is slow to recognize the economic principles which this metal, in conjunction with concrete, can undoubtedly lay claim to; and the following experiment, carried out at Beckton, under the instructions of Mr. G. C. Trewby, the Consulting and Constructing Engineer, may prove of some value to those engineers who at any time (in the future) may contemplate its introduction.

The manufacture of expanded metal is very ingenious, and consists in forming sheets of trellis or net-like metal out of solid plates of iron, steel, &c., by mechanically slitting and opening out the sheets, so as to produce diamond-shaped meshes of any size and thickness. There is no waste in the process, the product representing an iron trellis covering an area many times that of the plate operated upon.

The primary use of this expanded metal is for insertion in concrete structures subjected to tension, somewhat similar to the method of using a network or iron rods in the Monier system of cement construction. On examining samples, the peculiar form of the mesh will be noticed, and how admirably adapted it is for the purpose intended; and when one considers the remarkable manner in which structures are strengthened by inserting this metal, it is apparent what economies may be effected by its introduction.

The object of the experiment was to ascertain the strength of a 6-inch slab of concrete and expanded metal built on the channel-arch system, with a view of adopting the principle in a purifying-house floor. The result was quite satisfactory; but unfortunately the point of destruction or breaking strain was not reached, owing to the foundation subsiding. To some extent, therefore, the test was inconclusive.

Many tests of the kind have been made by various engineers, with remarkable results. The object has, however, generally been to obtain the very highest results out of the cement metal, regardless of the practicability on a large scale; and in comparing these tests with the experiment in question, the very short time the concrete was allowed to set must be borne in mind, and also the preparation and proportion of materials, which is of the utmost importance in the comparison.

The concrete consisted of ordinary Thames ballast, passed through a $\frac{3}{4}$-inch sieve, and portland cement of 112 lbs. per bushel, 10 per cent. residue on 2500-mesh sieve, 450 lbs. tensile strength after 28 days' immersion, in the proportion of one of cement to four of ballast. The expanded metal was in sheets 17 feet by 5 ft. 6 in. wide, 3-inch mesh, $\frac{1}{4}$-inch by $\frac{3}{16}$-inch strands.

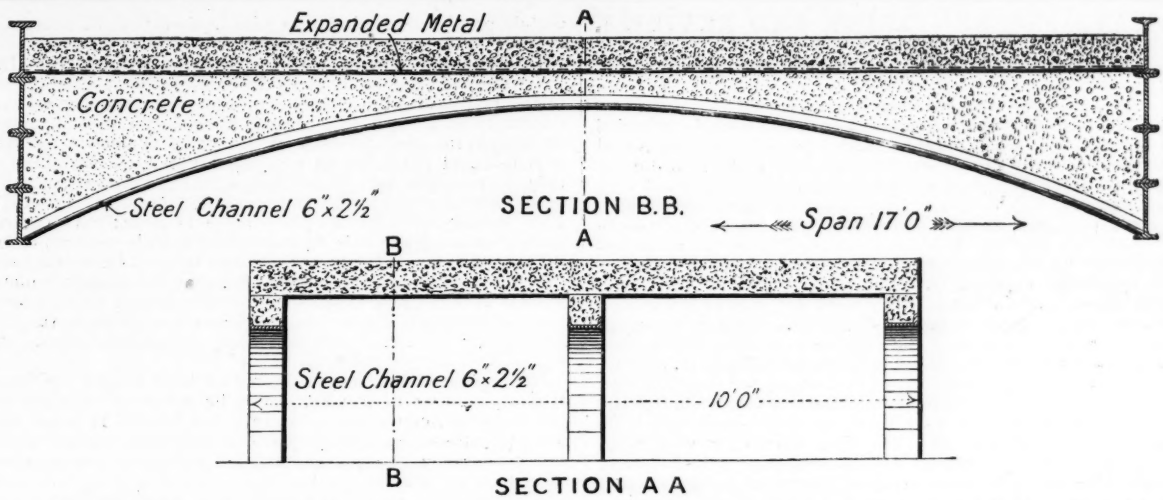
On referring to the diagram, it will be noticed that the structure consists of a 6-inch slab of concrete, 17 feet clear span by 10 feet wide, supported on three jack arches spaced at 4 ft. 9 in. centres. These arches are formed of curved channel-irons 6 inches by $2\frac{1}{2}$ inches section, at $12\frac{1}{2}$ lbs. per foot, with a rise of 2 feet in the 17-feet span, filled up with concrete 6 inches above the soffit; thus making a level bearing on which the slab rests.

The abutments were built with steel joists secured by five wrought-iron straps 4 inches by 1 inch; the foundation being ordinary railway sleepers, laid crosswise on the firmest ground that could be found.

The correct position for the expanded iron is at the bottom of the slab, as far from the neutral axis as possible, where the metal will meet with the greatest tension. In practice, the sheets are laid on top of the timber centering; the edges overlapping one another 3 inches. (To obtain a maximum of strength, the ends of the sheets should be welded together.) The concrete is then proceeded with in the ordinary way.

When the timber is struck, the metal will be found well embedded in the concrete, without any of the strands being exposed. After setting 34 days, weight, in the form of 56 lbs. per yard rails, was gradually applied. These rails were laid on top of a course of blue Staffordshire bricks, to ensure an evenly distributed load. With 27 tons on, a slight crack was observed running diagonally through the concrete of No. 1 arch about 6 feet from the north abutment, and a similar flaw was noticed in No. 3 arch in about the same position, when 38 tons had been put on. But as these did not widen out or extend in any way during the remainder of the test, very little importance need be attached to them, as no doubt they were caused by a slight spreading-out of the abutments. At this point, the average deflection of the three channels was $\frac{3}{16}$ inch. A certain number of rails were added each day until 100 tons—equivalent to 11·8 cwt. per superficial foot—was equally distributed over the slab; but this did not seem to have any effect on the structure—the deflection of the channel irons being 1 inch and the concrete slab barely $\frac{1}{2}$ inch. In places, the channel-irons parted a little from the concrete, but not more than $\frac{1}{8}$ inch.

After letting this weight remain for three weeks, an additional 26 tons were added; the result being a slightly increased deflection. Soon after commencing to load the next morning, it was seen that one corner of the foundation



was sinking, throwing the weight over on that side. No. 3 channel-iron showed signs of buckling close to the foot, and the concrete in the three arches began to disintegrate by the abutment; so that nothing more was to be gained by pursuing the experiment further. The total weight now evenly distributed over the structure was 128 tons 5 cwt., equal to 15·09 cwt. per square foot. The slab was carefully examined at this stage, and found to be quite intact, with a deflection in the centre of ½ inch. The average deflection of the channel-irons was $1\frac{3}{16}$ inches; all three keeping their shape very well indeed, with the full load on.

It may be of interest to hear that expanded metal has been used in many of the new buildings at Beckton for some time now, and with very satisfactory results. As an instance, the construction of eight concrete reservoirs for the bacteriological treatment of sewage may be mentioned. These were 60 feet by 37 ft. 6 in. by 4 feet deep; the walls of the reservoirs being entirely above ground, without any earth backing to resist the fluid pressure from within. Expanded metal was inserted, and the result was in every way most satisfactory.

Area of slab	170 square feet.
Structure finished	Nov. 2, 1899.
Commenced loading	Dec. 4, 1899.

Date.	Weight On.				Average Deflection.	Load per Square Foot.
1899.	Tons.	Cwt.	Qrs.	Lbs.	Inch.	Cwt.
Dec. 5	14	17	1	22	..	1·75
,, 6	27	10	3	22	⅛	3·24
,, 7	38	2	0	22	¼	4·48
,, 8	46	11	0	22	⅜	5·48
,, 12	54	14	0	22	$\frac{11}{16}$	6·44
,, 13	62	17	0	22	$\frac{13}{16}$	7·40
,, 14	71	0	0	22	⅞	8·35
,, 15	79	3	0	22	$\frac{15}{16}$	9·30
,, 16	87	6	0	22	1	10·27
,, 18	91	7	2	22	$1\frac{1}{16}$	10·75
,, 19	99	15	0	0	$1\frac{1}{16}$	11·74
,, 20	99	15	0	0	$1\frac{1}{8}$	11·74
1900.						
Jan. 16	126	9	3	0	$1\frac{3}{16}$	14·88
,, 17	128	5	3	0	$1\frac{3}{16}$	15·09

Discussion.

The PRESIDENT said this was not a paper which would probably require much discussion; but it was a statement of facts, and would be particularly useful to anyone who was thinking of carrying out similar work. He was sure Mr. Baker would be very glad to answer any questions, and would be pleased to hear the experience of anyone who had tried this or similar constructions.

Mr. S. GLOVER (St. Helens) asked in what position Mr. Baker put the expanded metal in the sewage tanks.

Mr. W. R. HERRING (Edinburgh) congratulated Mr. Baker on the lucid way in which he had laid the facts before the meeting. He had had the opportunity of seeing the experiment principally referred to in the paper, and was very interested in it. Some eighteen months ago, in designing a new purifier-house, he arranged for exactly the same kind of construction, except that his main girders were 20 feet apart, instead of 17 feet. With this exception, the diagram practically represented what he was about to do. He was glad to know that a floor with girders 17 feet apart was not seriously affected by a weight of 11 cwt. per foot. He was calculating on requiring a weight of only 4 cwt. The results of the experiments given had put all his doubts at rest; for he was quite sure the difference between 17 feet and 20 feet in the span would not counterbalance the difference between 11 cwt. and 4 cwt. in the load. He had also used the metal in conjunction with concrete at the bottom of a gasholder tank now just completed; the thickness of concrete round the base of the tank being 15 inches, rising over the cone to only 6 inches thick. It was a weak point; and it occurred to him to put in the expanded metal to strengthen it. He thought there could be no two opinions about the advantage of inserting a sheet of expanded metal which gave to concrete a diagonal and transverse bond, which without it concrete lacked. An entire building had been recently constructed at the Dublin Gas-Works with this metal. He had seen it used considerably in large warehouses in Manchester, both for partitions and floors. There was no doubt that the days of thick concrete floors and walls had gone by.

The PRESIDENT said that, like Mr. Herring, he was so struck with this method of constructing floors and buildings, that he lately recommended his Company to give an order for an overhead revivifying-floor built on this principle. He was about to erect a building with the walls made exactly on the same lines as had been described. Mr. Herring was quite right in saying that a very large building had lately been erected in Dublin on this principle; and he found that even on small buildings the price taken at per cubic foot worked out very favourably when compared with brickwork, while the weight put on the foundations was very much less.

Mr. BAKER, in reply, said that the only question put was that by Mr. Glover. The expanded metal in the case of the sewage reservoirs was placed within 3 inches of the surface of the outer walls.

Sunday Labour in Gas-Works.—We have received a copy of a pamphlet by Dr. Gritton and Mr. Peter Steel, entitled "Sunday Carbonizing in Gas-Works: Is it Necessary?" The chief feature in the present issue is that it appeals to Directors of Gas Companies, as well as to Managers. The compilers (it is taken entirely from professional sources—mainly from the "JOURNAL") hope that Directors may be induced to take an interest in this matter, and not leave the whole responsibility to their Managers. Those who plead insufficient storage accommodation may well refer to pp. 4 and 5 of the pamphlet, where appears a table of works (with moderate, or even small, storage) where Sunday rest is carried out. Copies of the pamphlet may be obtained by sending a post-card to Mr. Steel, 7, Carlton Road, Sidcup.

The Association of Gas and Water Engineers of Austria-Hungary.—The following is a list of the more important communications which will be made to this year's meeting of the Association, which, as already announced (*ante*, p. 798), takes place at Pressburg on May 24 and two following days: "An Account of the Gas and Water Works of Pressburg," by the Manager, Herr Berthold; "The Production and Use of Aërogene Gas, and High-Pressure Gas," by Herr C. F. Schweickhart, of Vienna; "Cooking by Gas," by Herr Schoene, of Dessau; "Practical Innovations," by Herr E. Blum, of Berlin; "Salzenberg's 'Kugel' or Ball Light," by Dr. W. Brix, of Vienna; "Governors," by Herr H. Kempler, of Vienna; "New Photometers," by Dr. A. Kauer, of Vienna; and "The Smoke Nuisance," by Professor A. Arche, of Vienna.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 1320.)

BUSINESS on the Stock Exchange last week was almost suspended on the opening day, by reason of the reception of the Naval Brigade. However, there was little business to do, so it did not much matter. And thenceforward everything continued very quiet and very flat. The weak speculators for a rise were gradually squeezed out; and by the middle of the week prices were about at their lowest. A slight reaction then set in, as intelligence from the seat of war came out brighter; and Consols, which had frequently changed hands at par, had a quick recovery. Other departments all round were very flat, and prices show a uniform and pretty considerable shrinkage. When the present long account is closed, and if the war news continues satisfactory, it is possible an improvement may be effected this week. In the Money Market supplies were more abundant; and discount rates were lighter, especially towards the close of the week. In the Gas Market, transactions were more numerous than they have ruled for some weeks past; but they were to a very large extent confined to the leading big issues, especially Gaslight and Coke. It almost goes without saying that changes of quotation are lower all round; for while every department in the Exchange has been depressed, the Gas Market has the additional incubus of the coal famine. Still there were no extravagant falls in value. In Gaslight issues, the ordinary had many dealings. The price on the opening day was 102. But this was not touched again; and it fell till, on Thursday, the stock changed hands at a discount for the first time. The lowest point touched was 99 on Saturday. There were considerable dealings in the maximum also; and both it and the debenture receded a point. South Metropolitan was only moderately dealt in; but the quotation was substantially set back. Commercials were quite quiescent; and the prices were unchanged. Very limited were the dealings in the Suburban and Provincial group; but everywhere the tendency was to shrink. Brentford, British, and Crystal Palace had to take lower quotations. Actual dealings in the Continental undertakings were few; and they were mostly in Imperial, which had a slight fall. But Union and European held firm. Companies located in the remoter world came in for little notice; and only River Plate had a slight fall. There was rather more activity in the Water Companies; and quotations had a general but very moderate reduction.

The daily operations were: On Monday, there was great activity in Gaslight issues; but hardly anything else was touched. The ordinary fell 1, British 1, and South Metropolitan 2½. In Water, New River receded 1, and West Middlesex 2. Business was much quieter on Tuesday; and Gas prices were unchanged. In Water, Lambeth 7½ per cent. fell 4, Southwark ditto 3, and Grand Junction 1. Gas stocks were not much more brisk on Wednesday, but reduction proceeded. South Metropolitan and Crystal Palace relapsed 1½, Gaslight maximum 1, and Tuscan ½. Lambeth Water fell 1. The tendency was the same on Thursday. Gaslight ordinary and debenture dropped 1, South Metropolitan 1½, Imperial 2, and British ½. In Water, East London and Southwark fell 2, and Grand Junction and Lambeth 1. The lowering process was continued on Friday, when Brentford new was moved back 5, and River Plate ¼. Saturday was quiet and unchanged.

ELECTRIC LIGHTING MEMORANDA.

A View of the Paris Exhibition—Electricity at the Exhibition—Electric Automobiles—Electric Power Schemes in Parliament—The "Electrician" is Silent.

THE Paris Exhibition being more or less open, it follows naturally that the local correspondents of the principal English newspapers should begin to send over their valuable impressions of what there is already to be seen in the big show. International Exhibitions are familiar enough affairs now; and it is well understood that all enterprises of the kind appeal to two standards for judgment—first as a spectacle; secondly, as registering the height of achievement in the various classes of exhibits. As a spectacle, the present Paris Exhibition should be, and probably is, the finest thing of the kind yet produced. Comparisons can only be had with the famous "White City" of Chicago; and it is pretty safe to conclude that French taste, exercised at home, will show an improvement upon the exported sample of it which almost persuaded the Americans that they, too, are an artistic people. So far as the spectacular interest of the Exhibition goes, the ordinary newspaper correspondent is as well qualified as any, and better qualified than most, to pronounce an opinion on the merits. When it comes to the question of the merits of different classes of exhibits, however, the newspaper reporter is necessarily out of his depth in attempting to guide public opinion. This appears conspicuously in a recent article published by the "Daily News," which affects to describe what the Exhibition has to offer as a record of the progress of electricity.

We get here a statement that the Electrical Palace is the most striking building in the Champ de Mars, which is not far wrong. It is further remarked that the contents of the electrical sections of the World's Show are a marvellous justification of certain prophecies made in the "Daily News" eight years ago concerning the potentialities of electricity, "not only as a source of light, but even more as a source of mechanical power." The latter sentence, of course, gives the reporter away as belonging to the majority of those people who take the popular view of electricity as being a motive power as well as a form of energy. As regards the progress made of late years in electric lighting, it is asserted that even so recently as the Paris Exhibition of 1889 the methods and styles of lamps, and the fixtures generally, were "almost primitive in contrast with those now exhibited." This is, indeed, surprising; but there is more: "As regards motive power, the *trottoir roulant* is only a single instance of the manner in which the natural force may be used for public locomotion." After this, the observation that the electric tramcar is "one improvement which should be introduced with the least possible delay into English streets," lets the reporter down quite gently. He must have been fast asleep somewhere between the successive Paris Exhibitions.

Lastly, this witness marks the automobiles among the latest of all the glories of France. True, he mixes up together oil, gas, and electricity motors; but that is a detail. It is not very clear, from his account, whether electric carriages, self-contained, are or are not a strong feature of the collection now on view. Of course, we are informed of the views of a French electrician as to the part which electric road carriages "may yet" play in reviving travel in the sense in which the word was understood before the railway era changed its significance. People do not so much "travel" by railway, as go from place to place. There is no land travelling, properly so called, off the common highway. Is the electric carriage going to restore the road as a means of making oneself acquainted with men and cities? All that is told us to the purpose is that the electric carriage needs no horses, and is cheap. The first statement is true, if trite. The second is otherwise. It is admitted that the "electric machine" gets exhausted after a time, and must be replenished. Before it can be used on a really grand scale, "there must be established here, there, and everywhere depôts for the supply of electric energy." Why, if electricity is itself a motive power? If this artless reporter were to look around him, he would find more "depôts" where electric energy might be had, at a price, than electric cars to make locomotive use of it.

Electrical power and tramway schemes have kept the electricians busy at Westminster during the past week. Sir James Kitson's Committee have got fairly to work upon the Electricity Generation in Bulk Bills; while an interesting project for connecting Manchester and Liverpool by an express electric railway on the Lartigue mono-rail principle, was also brought forward. By the latter scheme, it is proposed to run trains every few minutes at a speed of 110 miles an hour; and the Bill is opposed by all the existing transport and local governing interests. The Tyneside Electric Power Bills were the first to be taken; and it is an illustration of the crowded industrial condition of this country, that the intrinsic merits of electrical power generation and supply in bulk hardly emerge from the incidental clashing of local and particular opposing interests. It is impossible to gather from the evidence so far given whether Parliament would be justified in handing over the important areas scheduled to the particular Companies promoting these Bills; but some strong testimony has been adduced to show that cheap electricity supplied on a large scale would revolutionize the industrial aspect of the northern "black country." One witness talked of taking a continuous supply of 5000-horse power for the manufacture of calcium carbide, at a price of little over half-a-farthing per unit. At this rate, almost anything is possible. Niagara, at any rate, would be out-classed.

The challenge we addressed last week to the "Electrician" to make good its astounding claim for superior accuracy of electricity-meters to gas-meters, has not been taken up in the current issue of our contemporary. We have scanned its columns carefully, without finding any notice of our imputation upon our contemporary's veracity or competence as a witness to the comparative accuracy of consumers' electricity and gas meters. A charge of this kind is only to be ignored at the price of a very obvious conclusion.

ON THE TYRANNY OF THE LABORATORY.

THE British Public have been treated of late years to much gratuitous advice as to the courses to be taken in order to enable the United Kingdom to keep its old place in the van of industrial and mercantile progress. We have been informed that our financial arrangements need amendment; that our patent system is wrong; that our principle of joint-stock enterprise is meretricious; that our workshop practice is antiquated; and that, in short, almost everything about English trades and manufactures is amiss. All this storm of criticism has, moreover, frequently risen to a hurricane in one regard—the asserted contempt of the English people as a whole for the imperative need of better education. We are assured by many clamorous voices that our workpeople want more schooling, and our leading hands and heads of industries more science. While far from denying the existence of some reason in this contention—of a great deal of reason, let us admit—it is equally certain that, unless British governing authorities and influential people generally keep their

heads in the multitude of these counsellors, the British Public will be in great danger of being sadly befooled from the other side. We have several times in these columns lamented the quality and the influence of that statutory system of elementary education with which the name of the late Mr. Forster is identified, and for which the nation pays in hard cash so much more than he ever expected. And now, with regard to the more recent agitation in favour of more science teaching for the chiefs of British industries, we venture to enter a protest against the growing and still more threatening Tyranny of the Laboratory Men.

We will not yield to anybody in respect for true science, for the scientific method, and for the men who give their lives to the search for, and the propagation of, the truths of science. But this sentiment of respect—of veneration—does not extend to the abuse which is occasionally made of the name of science, and of the recognized grade of membership of a scientific society, and merely means in many cases the acceptance of a title as a credential. Men, in their modern pride of progress, are accustomed to wonder at the fatuity of their benighted ancestors, who were content to entrust their greatest interests to a monarch, and after him to a nobleman, with touching confidence in the rectitude and ability of the crown or the hereditary peerage. Human nature, however, changes not, although its manifestations shift with the times. The faith which a Government Department no longer has in a lord, it reposes in a Fellow of the Royal Society. And many of the people are fascinated, not by the head of a man of science, but by his tail—of capitals.

We are moved to raise this subject here by something that transpired in the course of the recent Committee proceedings on the London County Council Bill for legalizing penalty gas testing by the portable photometer. It is a point that had better be taken separately, in this way, strictly as a question of general principle, without reference to persons. There are those who hold that all this pother would never have arisen, and that all the unnecessary outlay of public money on the promotion of and opposition to the Bill would have been spared, if the Board of Trade had not departed from the provisions of the City of London Gas Act, 1868, relating to the qualification of the members of the triumvirate called the Gas Referees. It should not be so commonly overlooked as it is, that this peculiar body exists solely by virtue of section 29 of the Act named, which runs as follows:—

> The Board of Trade shall as soon as may be after the passing of this Act, appoint three competent and impartial persons, one at least of them having practical knowledge and experience in the manufacture and supply of gas who shall be called the Gas Referees (and who are in this Act referred to as the Gas Referees), and in case of a vacancy happening among them by death, resignation, or otherwise, shall appoint a competent and impartial person to fill the vacancy, one at least of the three being always qualified as aforesaid.

It is unnecessary to specify the duties and responsibilities of the Gas Referees. These are stated in several Acts. In practice, they have come to be limited to affairs of gas-testing; but by the Gaslight and Coke Company's Act, 1876, section 28, the Referees have power to inspect the gas-works and take cognizance of the processes of manufacture "for preventing nuisance." The same power is enacted in the Commercial Gas Act, 1875, and the South Metropolitan Act, 1876.

The idea of this legislation obviously is that the Gas Referees should be a competent and impartial body of experts, having knowledge of the actual gas industry, as well as of the methods of the laboratory. It is notorious how the Board of Trade have lost sight of this ideal. The present Referees are Professor Vernon Harcourt, Professor Boys, and Dr. Haldane. Impartial persons, truly, and competent in their various specialities of chemistry, experimental physics, and physiology. But not one of them answers to the precise definition of the Acts of Parliament, which admits of no dispute. No man of business, or practical man of affairs, needs to be told of the consequences likely to follow—and which, as a matter of fact, have followed—from this ignoring of the practical and exaltation of the laboratory qualification for occupancy of a position of this nature. No man can jump off his own shadow. The London gas manager has to keep his holders afloat, send out good and clean gas, and pay shareholders their dividends. He has to think of how when, and where to buy coal, to sell coke and other commodities; and he has on his head the care of thousands of officers and men. And all the time he has to conform to the refined taste in testing of three honest and well-meaning gentlemen who need know no more about gas manufacture than about shoemaking.

Naturally, as are the Gas Referees, so are the Gas Examiners. The ordinary Gas Examiner may well be a chemist—not, perhaps, of the grade to which the complementary words "and druggist" usually belongs. But there is no statutory obligation, nor any common-sense reason, why any Gas Examiner, Superintending Gas Examiner, or Chief Gas Examiner should possess the peculiar qualification deemed necessary by Parliament in the case of the Referees. As the matter stands, however, they are all laboratory hands, with the defects of that in some respects excellent character. Their minds are apt to run in one groove. The weakness which besets them all is the tendency to overrate apparatus; and when the poison of officialism operates in them as well, there is the temptation to make a fetish of that which was only intended as a guide. What was originally a mere convention, comes to be regarded as one of those Laws of Science of which Dr. Poynting spoke so disrespectfully at Dover last year. We can see the result of too much laboratory and not enough out-door exercise in the bracing air of a gas-works, in the incessant fiddling with photometers and standards of light for use in connection therewith which has characterized the history of Gas Refereedom. Contrast this restlessness with the massive reliance of the French photometrists on the classic prescriptions of Dumas and Regnault, of 1860. Nobody can justly accuse French science of inferiority to the contemporary English studies in the same subjects; and if the methods and appliances of French gas photometry are the same to-day as they were forty years ago, there must be good reason for it.

This is not because the French believe these to be perfect. As the welcome extended to the suggestion of M. Violle shows, they admit that the national industrial standard of light—the carcel lamp—might be improved upon, from the point of view of pure science. But their legal gas photometry is a complete system, perfecty reliable for the purpose; and all parties know what they are about in respect to it. Consequently, the Paris gas testings are an unbroken series from the beginning; the returns for every "trimestre" being comparable one with another. For all industrial purposes, this is far preferable to the unsettled methods of Gas Refereedom. The French carcel lamp may not be a particularly good standard of light; but it is claimed to be uniform within 1 per cent. Similarly, the Bengel test-burner is an indifferent performer; but at least it does not vary. The Foucault photometer, and all the accessories, are work-a-day tools; and although the whole outfit is anything but portable, every Gas Examiner on the permanent staff can go, as he is ordered, from one testing-place to another, and obtain results which agree with those of the men who have preceded and will follow him. There is ample recognition in France of the essentially conditional character of the operation of determining the nominal illuminating power of town's gas by the photometer; and everybody concerned is satisfied to rest it on this basis.

It is scarcely necessary to inquire what would have been said if the Board of Trade had transgressed a statute requiring a member of a certifying authority to be an attorney, or a certificated medical practitioner, as the Department has ignored the requirement that at least one of the Gas Referees must be a person "having practical knowledge and experience in the manufacture and supply of gas." The London Gas Companies have been reluctant to insist upon their lawful rights in this regard; while the Metropolitan Authorities have been careful to use theirs to the utmost, and have tried to extend them. The Gas Companies, probably, have tacitly accepted the professors and doctors whom the Department have appointed to the office, in the faith that, as the duties have shrunk into affairs of the laboratory, men of the laboratory might be trusted to discharge them. But the recent proceedings in the Committee-room are calculated to rudely shake this confidence. Once more the common sense of a Parliamentary Committee has ventured to decide where doctors disagreed; and the erection of the photometer into a fetish has been stopped. Perhaps the Board of Trade may, by the same means, have been awakened to a sense of the obvious truth that the appointment to a Gas Refereeship is not necessarily an exception to the general rule for the interpretation of an Act of Parliament.

THE PRESS AND THE HIGH PRICE OF COAL.

THE scarcity and high price of coal—coming at a time when the public interest was riveted upon the campaign in South Africa with a more complete preoccupation than is noticeable now that the stress and anxiety attending the early days of the war have given way to a justifiable hope of speedy and successful termination—received only languid and perfunctory notice in the Daily Press. The announcement that the Railway Companies would be called upon to pay something like 50 per cent. more for their coal supplies during the ensuing year, has, however, aroused more general attention to the subject of the price of coal; and the question is being debated on all hands.

"The Times," in a well-informed leading article yesterday week, referred to the possibility that a great advance in the price of fuel of all kinds is in store for us. (Gas companies, at any rate, have not that to fear. The advance is not "in store" for them; they have had to meet it at close quarters.) Such changes, says our contemporary, "never fail to give birth to somewhat wild proposals. We are sure to hear of suggestions that the export of coal should be artificially checked, either by taxation or some other direct or indirect means."

> We shall be told that our home supply of coals should be kept as much as possible for home purposes. Excluding the case of Welsh smokeless coal, to which special considerations apply, it is needless to say that such measures are impracticable, and that, if they could be carried out, they would do mischief. Already foreign sources of supply are being made use of more and more by old customers, as we may only too soon experience. But for the present, no small part of our trade and our shipping depends on the fact that we can supply coal at rates which foreign consumers are still willing to pay. Any attempt to diminish the export of this article, would do ten times more harm than a sharp rise in the price at home. At the same time, such fluctuations are serious factors in the chief problems of industry. If every railway, if every large concern accustomed to make contracts for the supply of coal over a certain period is to pay 5s. a ton more, with a prospect of a still greater rise, there will be, as there ought to be, a disposition to try to shift the burden to other shoulders than the consumers of coal.

The article proceeds to point out that one of the chief lessons

of such a situation as that now existing is the need for improved methods of coal production, leading to economy and consequent lower prices.

The doubt which a large advance in the price of fuel must suggest to persons conversant with the number of days and hours which the miners work, or with the restrictions placed by trade rules, is whether the production might not be much more economical than it is. We might indicate a score of points at which there is room for improvement. One only need be referred to—the free application of labour-saving appliances, and extensive substitution of machinery for the manual labour. . . . With the latest advances, the [Durham] miners' wages stand 46¼ per cent. above the wages of 1879. The point here suggested is not that this rise is unreasonable, having regard to the "boom" in certain trades and the great demand for coal; our doubt is whether, in regard to the production of coal, largely controlled by highly-organized bodies, there has been what comes in other industries in the wake of increased expenditure—a recasting of old methods, a free introduction of labour-saving appliances, and an abandonment of rules and practices which necessitate two men doing what one is competent to perform. A few years ago it would not have been worth while mooting the point, if only because Trade Societies would have taken alarm and resisted changes, however innocuous. Now that it is understood that there is no desire or design in any quarter to undermine such organizations, one might look for a fairer and freer consideration of the problem how to work coal mines with the utmost economy.

The leaders of the great Unions have of late, the writer adds, been not unjustly credited with a growing sense of the responsibilities of their position.

There could not be a better way of showing this than by recasting some of the rules which stand in the way of a rapid application of economical methods. . . . Just as employers ought to revise their modes of production and distribution, so ought the employed to reconsider not a few of the articles in their code of rules; and never was there a time in which this could be done with greater ease than the present, in more than one industry, including coal mining.

If the present state of the coal market should really demonstrate, in the manner suggested, an access of reasonableness to the counsels of the Trade Unions, some good would indeed have come out of the evil. But we will believe it when we see it.

The other leading morning paper to take up the question—the "Daily Telegraph"—printed on Tuesday last an article by their City Editor on "Coal Prices and their Effect." Referring to the threatened increase of 5s. on railway coal contracts, and the probable effects on railway dividends, he said—

Taking fifteen of the principal English lines, we find that the total consumption of coal for the past year amounted in money value to a little under £4,000,000, which was an increase on that of the year previous of nearly £700,000. If we are to assume that the aggregate coal bill will be increased 50 per cent., the total cost will mount up to the enormous sum of £6,000,000. . . . . It is hardly likely that increased cost of fuel can extend for an indefinite period. In the meantime, probably the different Boards will see fit to postpone outlay on improvements that are not immediately pressing until a more convenient period; and economies will probably also be introduced where possible. It may be that proprietors will have to submit to a reduction in their dividend; but there is no evidence as yet that this will be more than temporary.

As regards the effect upon shipping companies, it is added—

Much necessarily depends upon the stocks of coal derived from the Colonies, as well as upon the dates from which the new contracts run. We believe that in several cases supplies had been acquired before the last advance, which has caused so much excitement, was notified; but even so, the increased cost must still be very heavy. Taking the Peninsular and Oriental as a type of the big companies, we notice in their last report that the Directors stated the cost of fuel at the large total of £752,900, which exceeded that of the year previous by £116,050. There has been a suggestion that liquid fuel should be used in place of coal; and no doubt a considerable saving would be effected where a sufficiency of such fuel is obtainable. But it would involve some considerable outlay to adapt an existing fleet of old vessels to the new fuel, although we believe a new vessel could be fitted with all appliances for a few hundred pounds. Foreign shipping companies appear to be recognizing the advantages of the liquid fuel and utilizing them.

Another correspondent of the same journal discusses the question of how the Railway Companies are to meet such an increase in the cost of working. As regards the passenger traffic, he expresses the opinion that "it seems tolerably certain that the Companies will find it hard to secure recoupment from their passenger service." Will they be able to do so from their goods traffic? This question is of much importance to buyers of rail-borne coal.

It opens the whole subject of railway freight rates, and it would be impossible to discuss it adequately within the limits of a newspaper article. Suffice it to say that, while the companies may, and no doubt will, put up their rates on goods, and especially on coal, it must be remembered that their power to do so is regulated to a large extent by Act of Parliament, and that if traders are dissatisfied they can always appeal to the Railway and Canal Commission—a body not particularly sympathetic to increases in charges. It may be argued that the companies must reduce their expenses in other directions. But this is easier advice to give than to follow. Bitter experience has taught railway directors that curtailment of services, lowering of speeds, diminution of passengers' comfort, and so forth, are always false economies; for they cause a loss of traffic by no means commensurate with the saving effected. It is strange, but true, that the companies most lavish in their outlay are the most prosperous. The cutting down of expenditure must be done very warily indeed, or the result will be the reverse of what its authors intended. Enough has been said to show that the problem is one that bristles with difficulties of all kinds, and a solution will be hard to find. One remedy suggested is that the companies should purchase collieries and work them, using as much of the product as they need themselves, and selling the surplus to the public. Another, but far more drastic, suggestion, is for State limitation of the price of coal, together with abolition of the surface owners' right to royalties. There is a strong belief in most quarters that the present state of affairs will only be of a temporary nature, and that a drop in the price of coal may be looked for within a reasonable period. At resent, however, there is no sign of a slump. On the contrary, the coal dealers appear to think that the top prices have not yet been reached.

Then, under the heading of "The Coalowners' Threat," the "Financial News" remarks that the 5s. per ton has so far only been asked, not agreed upon.

As there's many a slip 'twixt cup and lip, so there's many a contrary chance between threat and performance. It is the opinion of some that the coalowners are merely bluffing. For our part, we think there is a little more than mere bluff in the threat, though we do think, also, that bluff is a notable factor in the situation. The coalowners must have been irritated by the railway companies' recent threat to raise the rates for the carriage of coal; and this may be their reply in kind. Further, the colliers are clamouring for increased wages, and it may be that the coalowners are putting forward this threat of advance partly to recuperate themselves if they have to give way to the men's demands, and partly that they may have a good excuse for refusing the demands if the 50 per cent. advance in price is not brought off. The coalowners see trade very brisk and the values of all commodities rising; they have a practical monopoly of a most necessary commodity. Why should they not try to get as big a share of the plunder as possible? That is how they are reasoning. They mean to try for an increased price; but we can hardly think that they will, or that they anticipate that they will, get so big an advance as 50 per cent. upon their railway contracts, which were upon a handsome scale last year. We believe that, in the upshot, it will be found that the new contracts will be somewhat higher than the old, but will not be 50 per cent. higher. Another consideration worth noting by railway shareholders in quest of consolation, is that the present upward run of prices, whether in coal or in other commodities, is of temporary duration; so that, even though their dividends may be slightly affected for the next two, or two or three, half years, the depression will pass. In that way, it will help to steady dividends; for the high-priced coal will be bought during the exceptionally busy times we are now experiencing, and as these times die down, so will working expenses, as affected by the price of coal. But a word to the coalowners will be in season. Let them remember that sauce for the goose is sauce for the gander. The Legislature interferes with the rates of railway companies; it will only be fair that it shall interfere also with the coal trade, if that interest uses its monopoly power in an extortionate fashion. Meanwhile, no better politico-economic cry could be urged by the nation upon the Legislature than the reimposition of the export duty upon coal. That duty would moderate prices to the home consumer.

RECENT PUBLICATIONS.

Iron Corrosion, Anti-Fouling and Anti-Corrosive Paints. By Louis Edgar Andes. Translated from the German by Charles Salter. (Scott, Greenwood, and Co.)

Every gas engineer is interested in the subject dealt with by M. Andés in the above-named work; rust being one of those evils which is generally present with him. As the author points out, where it has once gained a footing, it is difficult, if not impossible, to eradicate it; and its formation in places inaccessible to periodical examination may, by the corrosion of screws and rivets, readily endanger the safety of an iron structure. The strength of a chain, as is perfectly well known, is that of its weakest link; consequently it is highly desirable that the deleterious action of rust should be reduced to a minimum. The author reviews, in a book of about 270 pages, the various anti-fouling and anti-corrosive compositions in use. Paints containing linseed oil or its derivative, linseed varnish, have, he says, been found to be the best of all protective media against rusting. For many purposes, however, the cost of oil paints is out of proportion to their durability—for example, the painting of iron pipes to be laid underground, ordinary cast-iron articles, &c. These objects, however, should not be left unpainted; and hence use is made of coal tar, or, better still, a solution of coal-tar pitch in benzene or petroleum. Before its use, however, for this purpose, the tar should have been purified from all constituents of an acid nature; otherwise the metal, instead of being protected, will be more readily rusted than ever, since even very weak acids give it a tendency to oxidation. Tar is highly suitable for filling in the interstices of screws, nuts, and rivets; and it will neither contribute to, nor allow the formation of, rust. The author goes fully into his subject, and the translator has been successful in reproducing in another language what he has to say. There are given in the text numerous illustrations of the rusting of iron, prepared in the course of a series of personal experiments on the formation of rust.

The Boroughs of the Metropolis: A Handbook to Local Administration in London under the London Government Act, 1899. By A. B. Hopkins, M.A. (Bemrose and Sons.)

The passing of an Act so honeycombed with references to other Statutes as the London Government Act of last year, is naturally followed by the publication of numerous handbooks to interpret the references, and to make intelligible the alterations to previously existing authorities, and the exact powers conferred, and duties imposed, upon the newly-created bodies. Of the books published for this purpose, none that we have seen is more complete than that compiled by Mr. Hopkins, whose term of office as Chairman of the Highways, Water, and County Rate Committees of the London County Council necessarily afforded him special opportunities for acquiring a thorough knowledge concerning the Metropolitan Local Government. The plan of the volume includes a historical introduction—recalling the horrible chaos existing in London government not so many years since—which is commendably brief and free from "padding;" the terms of the Act, explained by copious notes, and intercalated with the sections of the Statutes therein referred to; the text of the Act given by itself (a useful arrangement, as the sections scattered over 120 pages of notes and other matter are not convenient for reference when the text only is required); some dozen appendices; an index to cases cited;

one to Statutes cited; and a general index. The whole constitutes a very full and useful guide to the law which will come into operation next November.

Elementary Practical Physics. By Henry Stroud, M.A., D.Sc. (Methuen and Co.)

The series of text-books on Technology, published by Messrs. Methuen and Co. (under the editorship of Professor W. Garnett), to fulfil the requirements of students preparing for the examinations of the City and Guilds of London Institute, is distinguished by the success with which the volumes have been suited to their purpose—being neither too rudimentary in their teaching, nor too abstruse. Professor Stroud's treatise on Elementary Practical Physics possesses these characteristics to the full. The book is intended for guidance in practical work in a physical laboratory, and contains instructions for the conduct of numerous experiments which are designed to prepare the student for the more advanced laboratory work he has to undertake before he is fitted for the higher examinations in Physics. These instructions are illustrated by sketches of the required apparatus; the diagrams being very clearly and carefully executed. The arrangement of the matter is also good. The book is an excellent one for the use of student engineers.

Elementary Practical Chemistry and Qualitative Analysis. By Frank Clowes, D.Sc., and Professor J. B. Coleman. (J. & A. Churchill.)

This is a smaller and more rudimentary treatise than the work on Qualitative Analysis by the same authors, which is well established as a text-book for analytical chemists. It covers, moreover, the ground of elementary chemistry generally, and deals with quantitative as well as qualitative analysis. The reputations of Dr. Clowes as Chemical Adviser to the London County Council, and of Professor Coleman as the Professor of Chemistry at the South-West London Polytechnic, are sufficient guarantee of the practical value of the instruction contained in this volume. This instruction is designed rather for the student who requires to possess a knowledge of chemistry to assist him in the profession he intends to pursue, than for him who is qualifying for a professional and analytical chemist. For this purpose, the subject matter is well designed. The text is fully illustrated.

Introduction to Physical Chemistry. By James Walker, D.Sc., Ph.D. (Macmillan and Co.)

This, although designated and intended for an introduction to the study of physical chemistry, is by no means an elementary work, nor adapted to the use of a student unacquainted with first courses in chemistry and physics. To the more advanced student, it is most valuable—being a work not only displaying the results of very considerable chemical research, but, in the selection and manner of presentation of the subject-matter, giving evidence of being compiled by a teacher as well as a student. The book is distinguished by the lucidity with which the more abstruse theories are explained and discussed, and by the much higher literary quality it possesses than is generally characteristic of text-books. Such subjects as the "Phase Rule," Electrolysis, Electrolytic Dissociation, and the Rate of Chemical Transformation, are treated in a manner well calculated to make them—as the author sought to render his work—of interest and help to the student, instead of their consideration constituting "an additional burthen on the memory, which is, to all intents and purposes, utterly useless." Professor Walker's work is one which every enthusiastic student of chemistry would gladly possess, but which the dabbler may be advised to leave to others. It would be wasted on him.

PERSONAL.

Out of 118 candidates, Mr. W. H. Maxwell, Assoc.M.Inst.C.E., has secured the position of Borough Surveyor and Water Engineer to the Tunbridge Wells Town Council.

The Leigh Town Council have approved of a resolution of the Gas Committee that the resignation of Mr. H. C. Page, the Assistant Gas Manager, be accepted, and that he be congratulated upon his appointment as Engineer of the Canterbury Gas and Water Company.

By inadvertence the letters "F.I.C." were added in the "Journal" last week to the name of Mr. Walter Grafton—pp. 1212 and 1238. Our attention has been called to the fact that Mr. Grafton is a Fellow of the Chemical Society, but not of the Institute of Chemistry of Great Britain and Ireland.

Many of our readers will be pleased to learn that Mr. Andrew Dougall, the Engineer of the Hull station of the British Gaslight Company, who has been on the Continent in order to recruit his health, has returned to England very much benefited; and he hopes to resume his duties at Hull very shortly. Mr. Dougall spent two months at Cannes, and one month at Mentone.

The Derwent Valley Water Board have appointed Mr. Edward Sandeman, the Corporation Water Engineer of Plymouth, to be Engineer to the Board at a salary of £1200 per annum for the first three years, £1350 from the end of three years for the following two years, and thereafter £1500. Mr. Sandeman has been in Plymouth for nine years. He was Joint Engineer with Mr. James Mansergh of the Burrator storage reservoir, and also constructed the pipe-line which has superseded the "Leat," which was the means of water supply to the town for some 300 years. Prior to his appointment at Plymouth, Mr. Sandeman was Assistant Water Engineer at Blackburn.

OBITUARY.

The death occurred, on the 3rd inst., at his residence, "Woodhatch," Reigate, of Mr. Thomas Burt Haywood, fellow Director with Mr. S. B. Boulton in the firm of Messrs. Burt, Boulton, and Haywood, Limited, and for many years his partner in the old firm.

Mr. Edward Willis, one of the Directors, for nearly six years, of the Rochester, Chatham, and Strood Gaslight Company, died last Saturday week, at the age of 74, after a brief illness. Among those who attended the funeral on Wednesday last, were Mr. J. J. Foord, J.P., Director, Mr. J. M. Veevers, Secretary and Engineer, Mr. W. H. Day, Chief Clerk, and Mr. A. G. Grant, Collector of the Rochester &c., Gas Company. The Chairman and other Directors also were among those who gathered at the graveside.

After several months' illness of a painful nature, M. Eugéne Breittmayer, the President of the Compagnie l'Union des Gaz, passed away on the 8th inst. His death will be very greatly lamented by the gas industry in France, and by the numerous friends which he had made on this side of the Channel. He had been connected with the Union des Gaz from its early days. He was the Vice-President in 1889; and the following year his colleagues showed their estimation of his character by electing him President on the death of M. Toché. M. Breittmayer was a very active man, and was connected with the direction of other commercial enterprises, among them the Mulhouse Gas Company. He was a Chevalier de la Légion d'Honneur, and a member and Past-President of the Socié é Technique de l'Industrie du Gaz en France, which body held him in very great respect. The funeral took place last Friday.

NOTES.

The Use of Oil for Laying Dust.

Further information is desirable concerning the utility of oil as a corrective of excessively dusty roads. Several references to the application of waste oil to lay the dust of railways and common highways in the various "black countries" of the earth's surface have appeared in engineering journals; and it seems to have been rather too hastily assumed that this treatment is a cure for the evil of dust. According to a report of the Chief Engineer of the Massachusetts Highway Commission, however, success does not invariably reward experiment in this direction. A section of road at a place called Cottage City, was so peculiarly exposed to sweeping winds that the binding material was removed long before it ought to have been worn down by the traffic, so that it was difficult to maintain the road surface in proper condition. For this reason, it was decided to try oil sprinkling, which was accordingly done over a length of 1800 feet, on the basis of 50 gallons of oil per 100 lineal feet of 15 feet roadway. The oil was first used in June, and was at first thought to be a great success, as no dust blew from the section treated; while from the rest of the road it blew in clouds. The benefit was not lasting, however, as a month later the stone began to unbind, and fresh binding material had to be used. There was also some complaint that the dust was injurious to the clothing of wayfarers.

Collapse of a Concrete Bridge in Paris.

Very great interest has naturally been aroused in the disastrous fall of an armoured or reinforced concrete bridge at the Paris Exhibition. This is the first time that the reliability of this new material of construction has been seriously called in question. One of the chief recommendations ordinarily offered in regard to the material, or the combination of cement concrete and iron or steel wires, is that when it does collapse the fall is gradual and not complete. When, therefore, it became known that a bridge of this construction had fallen in Paris so suddenly as to kill a number of people who happened to be passing underneath it, the credit of the principle appeared to be shaken. From particulars specially reported in the "Engineer," it is possible to form an opinion as to whether the collapse of this bridge was due to the faulty method of construction or merely to particular and accidental causes. Apart from all questions of the design of the bridge, there is ample evidence to show that the centering was removed too soon; pieces of the concrete afterwards picked up being still pasty. This being so, it is unnecessary to carry the inquiry further as regards the trustworthiness of armoured concrete as a material of construction. It once more appears that good cement, and the utmost care in preparing the concrete, are of the essence of this method of building; and also, of course, that the setting cannot be hurried.

Proper Position of Air Inlets and Outlets for Ventilation.

Mr. Mervyn O'Gorman, in a paper on the ventilation of large buildings, admits the difficulty of a satisfactory solution of the

problem of bringing 1000 cubic feet of air past every person's breathing level in an hour, without creating the sensation of draught. Mr. O'Gorman's conditions of good ventilation include comfortable warming by radiant heat, not by hot air. The admitted air must all cross the breathing level; and the difference between the dry and the wet bulb thermometers must never be more than from 3° to 9° Fahr. Otherwise parching is felt, and rapid evaporation gives the feeling as of draughts. The pressure plenum system of ventilation is, he says, the only one which enables the necessary operations on the air to be fully controlled. The author advocates the plan of warming up churches, and similar buildings in occasional use, to 100° Fahr. before the people begin to enter. This prevents after-chills by the heated air coming into contact with the cold roofs and walls. The inflowing air should be washed by a water spray, preferably with the addition of a coke filter. The inlets should be trumpet-shaped. On the whole, the most efficient arrangement for getting the fresh air to move along the breathing line, where it is wanted, is stated to be by admission near the top, discharge at the bottom below the inlet. This disposition of inlets and outlets is given on the authority of experiments made in the United States by Mr. Warren Briggs. It is highly important, as it is capable of being applied both with plenum and with non-mechanical methods of ventilation. Confirmatory experiments are, however, desirable.

Krypton.

It is now some time since the world has heard anything fresh concerning the hidden elements in the atmosphere whose existence was demonstrated by Lord Rayleigh and Professor Ramsay. Recently news has come from Berlin respecting some work done by Professors Ladenburg and Kruegel, on the most recondite of the new elements—that named by Ramsay krypton, because it is so hard to get at. After working much with liquid air, the experimenters thought it possible to get hold of some krypton, with the intention of finding out more of its properties than Ramsay had been able to ascertain with his limited acquaintance with the strange element. After much trouble and many mishaps, the authors were able to procure 3 litres of the evaporated residue of 850 litres of liquid air. The gas from this was collected in large holders. The oxygen and nitrogen were separated out from the residue; and finally 3½ litres of nondescript gas remained. This was condensed in liquid air, which it did very easily and completely; the product being a transparent colourless fluid in which floated a small number of colourless crystals. The liquefied gas was fractionated into several holders, whence it was bottled off for spectroscopic examination. The contents of several of the bottles exhibited beautiful spectra of argon; and some of them showed the green and yellow krypton lines. One bottle, which was filled with the evaporation from crystals, proved to contain almost pure krypton, with a density of 58·8, which would give it a place just before copper in the periodic scale.

The Visit of Gas Engineers to Woolwich Arsenal.—A correspondent thinks it would be well for the members of the Institution of Gas Engineers who paid a visit to Woolwich Arsenal last Thursday week to know that the current number of the "Royal Magazine" (published by Pearsons) contains a very interesting article, well illustrated, on the operations there carried on for the manufacture of arms and armaments.

German Association of Gas and Water Engineers.—The programme of the fortieth annual meeting of this Association has now been issued; and we give a list of the more important papers and reports which are to be read. The meeting takes place, as already announced (*ante*, p. 862), on June 9 to 13 next, at Mayence, under the presidency of Herr W. von Oechelhaeuser, General Manager of the German Continental Gas Company. The General Secretary of the Association is Dr. H. Bunte, of Carlsruhe. Those attending the meeting will assemble on June 9 for an evening reception. The reading of the technical communications will take place on the three following days; and June 13 will be devoted to an excursion. The President will deliver an Inaugural Address; and this will be followed by papers and reports, the chief of which are as follows: "The Gas, Water, and Electricity Works of Mayence," by Herr Kuhn; "Mixed Gas," by Dr. H. Bunte; "Power Gas and Furnace Gas-Motors," by Professor E. Meyer, of Göttingen; "The Illuminating Value of Mantles," on the basis of tests made at the Imperial Physical-Technical Institute; "A New Method of Incandescent Gas Lighting," by Herr Mollberg, of Greiz; "Results of Working the Process for the Simultaneous Removal of Naphthalene and Cyanogen from Gas," by Dr. J. Bueb, of Dessau; "Coal Conveying Machinery," by Herr Weiss, of Zürich; "Storage and Spontaneous Ignition of Coal," by Herr Söhren, of Bonn; "The Use of Gas Coke," by Herr A. Oslender, of Düsseldorf; "The Use of Woltmann's Fan for Measuring Water," by Herr Rother, of Leipsic; and the reports of the several Committees of the Association on "Rules for the Protection of Gas and Water Mains from Electrolysis," "Gasholders," "Photometry," "Heating," "Gas-Meters," "Water Statistics," "Water-Meters," and "Instruction." Visitors are invited to attend the meeting; and a special programme of arrangements is issued in the interest of any lady visitors who may attend the meeting.

COMMUNICATED ARTICLE.

THE QUESTION OF AN EXPORT DUTY ON COAL.

By a Correspondent.

The question which readers of the "Journal" have been invited to discuss—namely the advisability and wisdom, or otherwise, of imposing a heavy duty upon coal exports—is an important and interesting one, to which attention is naturally drawn by the present dearness and scarcity of coal; especially as the dearness and scarcity are largely due to the increased and increasing quantity of coal sent out of the country.

The suggestion to impose such a duty is (as has been shown in these columns of late) not a new one. Indeed, an export duty was actually put upon coal in 1842 by Sir Robert Peel, but was remitted by him in 1845—it being "admitted to be a failure"—and coal has been exported duty free, in increasing quantities, ever since. The question was revived in 1860, and much discussed by both Houses of Parliament—being made the subject of an amendment to the motion approving the Commercial Treaty with France, by the eleventh article of which the English Government undertook not to impose a duty upon exports of coal to France during the ten years following the notification of the treaty. Mr. Gladstone, who was then Chancellor of the Exchequer, declared that such an interference with the trade of the country as an export duty on coal would entail, could not be entertained. The report of the debates on the treaty (see "Hansard," 8 and 9 March, 1860) affords very interesting reading, and shows clearly the then prevailing ignorance respecting our coal supply. The estimates given to the House by Mr. Hussey Vivian (as he then was) as to the extent of the British coal resources decidedly erred upon the side of optimism. The Welsh coalfields alone, he said, contained 500,000 million tons, which computation does not exactly approximate to the subsequent estimates of the Royal Commissioners, who put the coal resources of the British Islands at less than 200,000 millions.

The Select Committee of 1873, with the report of the Royal Commission before them, adhered in their report (on the tone of which adverse comment has been made in the "Journal") to the decision of the House of Commons thirteen years previously—namely, that the true policy of this country is to leave the coal (as it leaves every other) trade free of duty restrictions. The question now proposed for discussion is, whether the experience of the quarter-of-a-century that has elapsed since the Committee reported justifies a reversal of its decision, and the imposition of a 50 per cent. *ad valorem* export duty on coal. I contend and will endeavour to show that the answer is in the negative.

The proposal for this discussion is accompanied by a general calling into question of the *dicta* of arm-chair Economists such as Ricardo and Mill, and a depreciation of Cobdenism as being commercialism cemented by enlightened selfishness. [Before passing to the examination of the main question, may one be allowed to express a small feeling of surprise and regret that so essentially level-headed and unsentimental a paper as the "Journal" is, should even appear to endorse the modern idea that commerce can defy the laws of economics with impunity.] The besetting weakness of arm-chair Economists is said to be their propensity to refer every particular question to general principles. Is it not rather true to say that there are certain laws governing commercial economy which the economists do but point out, not invent; that, like every other natural law, those laws cannot be defied with impunity; and that, therefore, it is but elementary wisdom to consider every particular question in the light of those laws? Isaac Newton had a way of binding every question of mechanics to the Procrustean bed of his general deduction from the falling apple; but one would not describe his refusal to ignore the law of gravitation as a besetting weakness. The statement of a contemporary that "if our exports of fuel fall off to the extent of a million sterling per annum, our imports must decrease correspondingly," is instanced as a piece of pure economic doctrine that is open to question. It is asked: "Is it certain that it is necessary to export coal in order to pay for foreign wheat, and cotton, and wine? Could not its value be made up by something else?" Surely not. We export coal because other nations ask for it; and if a man ask for coal, it is no use offering him a piano or a suit of clothes. It is demand that makes trade. It is true that part of our coal exports might be replaced by the export of the goods in the manufacture of which that coal would be used abroad—though only if the supply of labour was equal to producing a larger quantity of goods than before. But would not that be really equivalent to exporting the coal used in their manufacture at home? In fact, what argument can be adduced in favour of prohibiting or reducing the export of coal that could not be urged with equal force in favour of prohibiting or reducing the export of goods requiring coal for their manufacture?

But, further, assuming for the sake of argument that it would be possible to substitute for coal exports, manufactured goods that required little or no coal for the processes of their production, is it not obvious that, before these goods could be made, the raw material for their manufacture would have to be imported? What are you then going to export to pay for the additional imports? Coal, or what?

What would, then, be the effect of imposing, say, a 5s. duty on

exported coal? It would necessarily either be prohibitive of that export, or would reduce the export and raise the price on what was exported, or would raise the price 5s. on the whole quantity abroad. It obviously could not be prohibitive and revenue-producing at the same time. Assuming, first, that a duty was imposed such as would stop all exports, what would be the result? To reduce the price at home? "Yes," at the present time; but in the normal condition of the coal trade, when coal is sold at a price only sufficient to earn a bare margin of profit, "No." As, therefore, it is certain that in the ordinary course of events—increased production overtaking reduced consumption—the present high prices will give way to normal, an export duty imposed now could only be effective in hastening an inevitable fall. The consumer would, therefore, only benefit by the possible (though not certain) prevention of rarely-occurring periods of relative scarcity. How about the colliery-owner and the miners? The stoppage of exporting coal would throw out of work about 150,000 men; many collieries would have to shut down; and the owners would be ruined. For what purpose? That the exhaustion of the British coalfields might be postponed from, say, the year 2200 to the year 2250!

I have said that the prohibition of exports would not necessarily prevent periods of relative scarcity. That this is so will be seen on consideration; for it is obvious that the collieries of the country would be obliged to reduce their output to the home demand. That done, a sudden "boom" in the iron trade, and coal might be as relatively scarce and dear as it is at the present moment. What benefit would the gas industry reap, then, from the compulsory hoarding of our coal for the benefit of posterity? Absolutely none.

Meantime, the immediate effect on the nation generally would be that imports would be enhanced in price, while the buying capacity of the nation (its exports) would be lessened by about 20 millions a year—the value of the coal now exported. The imports would be enhanced in cost, first by the fact that coal would be scarce and dear in the countries that now import it from us, and goods manufactured (or corn grown) there would consequently be dearer by reason of increased cost of production in regard to the first, and of railway carriage in regard to both; and, secondly, by the higher charge for freight which the ships bringing the goods to this country would have to pay, owing to their being obliged to return without the cargo of coal which so many of them now carry on their outward voyage. That this is not merely the speculation of an arm-chair Economist, can be seen by a reference to a paragraph in a recent number of the "JOURNAL" (p. 1053), on the "Russian Coal Difficulty," in which it is stated that one of the consequences of the cessation of coal imports into the Black Sea—owing to the imposition of an import duty there, equal in effect, of course, to an export duty here—has been the rise of freights on grain. We import about 10 million pounds' worth of grain yearly from Russia.

If, however, we look to manufacturing or producing the goods instead of importing them—supposing that to be possible, and we cannot, for instance, produce silk or grow sufficient corn to feed ourselves—should we not be stimulating once more the production of coal, and defeat the aim of the duty, and moreover be resorting to protection, pure and simple? For we only import that which can be more cheaply produced abroad than at home. Let the truth be writ large that export duties are protective in character as clearly as are import duties, and are as damaging to trade.

Prohibition of coal exports would, therefore, seriously cripple the trade and impoverish the population of the country, without really, in the event, benefiting the consumer of coal. Were the duty restrictive merely, the same results would ensue in a lesser degree, with the same absence of real benefit to the consumer. In the improbable, if not impossible, event of the duty not reducing the volume of trade, an enhancement of import values would ensue in consequence of the increased cost of coal abroad; and the non-taxpaying classes would be taxed for the benefit of the taxpayer, unless import duties on tea, cocoa, tobacco, &c., were to be remitted out of the coal duty. But is it conceivable that a duty on coal exports would not reduce their volume; and even if it did not, what good end would be served by its imposition? It would be merely a piece of fiscal tinkering.

Look at it how one may, the conclusion is inevitable—that unless the British nation is prepared to say: "Our season of prosperity must end when our coal runs out; let us therefore now take a back-seat among the countries of the world, and, by keeping our coal to ourselves, live a second-rate existence in order that our posterity of three centuries hence shall have coal to use" (by which time the distance of the coal supply from the place of consumption may be an insignificant factor), the nation must go on turning its coal into exchangeable forms of wealth as fast as the demand requires. That the British people will consent to commit commercial suicide now, for fear of what may happen to their descendants a century or two hence, is a very remote possibility.

The necessity for economy in the use of coal is quite another, and a most important, question. It is one thing to advise a man to circulate, and thereby increase, his wealth, rather than to bury it in the ground; another not to tell him that he is foolish to throw some of his money into the sea, because he has plenty more. The man's posterity would thank you for giving the first, but curse you for not giving the second piece of advice. Is it then foolish to turn coal into that which will increase by use.

TECHNICAL RECORD.

THE INCANDESCENT GAS-MANTLE AND ITS USE.

By VIVIAN B. LEWES, F.I.C., F.C.S.

Chief Superintending Gas Examiner to the Corporation of London, Professor of Chemistry at the Royal Naval College, Greenwich.

[The First of a Course of Three Cantor Lectures at the Society of Arts delivered May 7, 1900.]

Great as has been the advance in incandescent gas lighting in England during the past eight years, we are still much behind Continental practice; and whereas in many towns in Germany from 80 to 90 per cent. of the gas-burners are of the incandescent type, in London the percentage would hardly reach 20. This, of course, is largely due to the ability with which the English Welsbach Company have hedged around their great monopoly, and have kept up the price of burners and mantles; so that, though in Germany you can buy an incandescent burner and mantle for a mark (1s.), it costs the English consumer 4s. The fact that a union-jet nipple can be obtained for 1d. compensates with a very large class of consumers for the fact that they obtain only one-tenth the amount of light from their gas that the larger outlay would render possible.

All burners owe their light-giving powers to incandescence; and the gas-flame which emits light because of the glowing particles of carbon within the envelope of the flame, has just as good a claim to the name "incandescent" as the mantles which the term always now conjures up in our minds, the principle of which consists of consuming the coal gas in an atmospheric burner with a non-luminous flame, so as to obtain the maximum amount of heat, and replacing the carbon particles by finely-divided rods or threads of non-combustible oxides with a greater power of emitting light when heated to a given temperature than the original carbon particles possessed.

Producing light by heating refractory bodies to incandescence is entirely an outcome of the nineteenth century, and dates from 1826, when Drummond first showed that a piece of dense lime could be raised to intense incandescence by the heat of the oxy-hydrogen blowpipe-flame; the lime at later dates being replaced by buttons or discs of magnesia, and also by zirconia. When using a comparatively large mass of material, as was done in these earlier experiments, the temperature needed to secure incandescence was above that which could be obtained by the use of air as the supporter of combustion; and it was a considerable step forward when it was realized that, by attenuating the body to be heated, and choosing a highly refractory material of low conductivity, an ordinary flame would give the temperature which, with the larger mass, had required the use of such costly appliances as the oxy-hydrogen blowpipe.

Even before the middle of the nineteenth century, the general principles upon which the incandescent mantle of to-day is based were known; for we find that Talbot, in an article on "The Nature of Light," published in the "Philosophical Magazine" in 1835, stated that "paper soaked in a solution of chloride of calcium, and burnt in the flame of a spirit lamp, leaves a white network of ashes, which, when held in the feeblest alcohol flame, emits a brilliant light." This experiment contains the germ of incandescent gas lighting, and embodies the principles adopted at the present day—namely, the saturation of a natural combustible fibre with the salt of a metal, burning off the organic matter, and leaving a skeleton of the oxide of the salt of the metal used, in so finely divided a condition that, on being subjected to the heat of any ordinary non-luminous flame, it becomes incandescent.

Four years afterwards, Cruickshank took out a patent for a cage or mantle of fine platinum threads woven together, and of such a shape and size as to thoroughly envelop the outer portion of the flame which caused its incandescence. Cruickshank, however, noticed that the luminosity of the wire was not so great as that emitted by heating the oxides of certain metals. He therefore attempted to increase the light-emissivity by coating the platinum wires with a paste of such oxides, but without much success, as it was found impossible to make the paste adhere to the surface of the wires for any length of time.

In 1848, Gillard first put the manufacture of water gas on a comparatively successful footing, by introducing the principle of raising carbonaceous material to incandescence in a cupola furnace by an air-blast, and then injecting steam to form the water gas until the temperature fell, when the steam was cut off and the fuel again "blown" up to the necessary temperature to make water gas once more—a process which is the basis of all modern water-gas practice. Water gas—consisting of nearly equal volumes of hydrogen and carbon monoxide—burns with a non-luminous flame; and desiring to utilize it for lighting purposes, Gillard devised a cap or mantle of fine platinum wire, which was suspended in the flame and heated to incandescence. For some months, this method of lighting was in use at Passy and Narbonne. But the trouble which has wrecked all attempts to utilize mantles of platinum soon showed itself; and the light emitted by the metal filaments rapidly grew less and less under the influence of the burning carbon monoxide, and finally the mantles became so brittle that they fell to pieces.

In 1849, Frankenstein introduced a lamp in which the flame from oil or spirit was caused to heat to incandescence a netted

fabric coated with a thin paste of magnesia and lime, mixed with gum arabic. Owing, however, to the materials being merely pasted upon the fabric, and not soaked into it, these mantles were very fragile, and had no durability. Indeed, it is an impossibility to make a mantle exactly according to the instructions given by Frankenstein, who, as afterwards explained by Werner, really mixed with his ingredients a little common salt, whereby some of the oxides were converted into soluble chlorides, which soaked into the fabric, and so rendered the manufacture of the mantle possible.

So far, the work done had been to establish the form of the mantle and the principle of obtaining the material in a sufficiently fine state of division to become highly incandescent at the temperatures given by an ordinary flame; while Talbot had clearly indicated the way in which this might be done. The only non-luminous flames available up to this period were those of the spirit lamp and water gas. But at this epoch Bunsen, the greatest of Heidelberg's great men, was planning and fitting up those laboratories which have since then given so rich a harvest to the scientific world; and while considering the methods of heating which should be adopted on the working benches, his attention was called by one of his assistants—now Sir Henry Roscoe—to the then novel contrivance of a non-luminous gas-burner. Seeing at once the enormous convenience of such a source of heat, Bunsen brought his marvellous manipulative skill to bear upon the subject, and in a few weeks gave the world its "bunsen burner"—a burner which has done more for the gas industry than almost any discovery or invention connected with it, which has made coal gas possible and successful for fuel purposes, and has enabled it, in conjunction with the incandescent mantle, to hold its own against the threatened rivalry of the electric light.

The next step of importance in the history of the incandescent mantle was the replacing of lime and magnesia, which up to this time had alone figured as the constituents of the attempted mantles, by oxides of a more refractory character, and having the property of emitting a more intense light at the available temperatures. In 1852, Bergemann noticed that oxide of thorium, when heated to incandescence, emitted a beautiful light; while in 1863, Bahr, when heating nitrate of erbium upon a platinum wire, observed that it swelled up and left a residue of oxide, which emitted a brilliant greenish light. Having communicated this result to Bunsen, they made a joint investigation of the subject, the results of which were published in "Liebig's Annalen" for 1864, where they point out that the oxides of the yttrium group of metals, when heated to incandescence, emit a beautiful light of great intensity.

In 1878, Edison patented the idea of coating platinum wires with oxides of such metals as zirconium and cerium; the materials being applied as soluble salts, acetates, oxalates, or nitrates, which were then burnt off, giving a more coherent structure than was obtained by Cruickshank—the coated wires being afterwards heated by the passing of an electric current. It is evident, therefore, that by 1878 not only had the principles upon which the mantles of to-day are constructed been published, but the oxides of the rare earth metals had been recognized as incandescents.

In England, the first practical attempts at incandescent lighting were in the early eighties, when the Lewis incandescent platinum mantle and the Clamond incandescent light were for the first time brought to the notice of the public. The Lewis mantle consisted of a cylinder or cone of fine platinum wire gauze, fixed to the end of a bunsen burner; the gas being supplied at ordinary pressure, while a current of air was forced at considerable pressure up a central inner-pipe, the injecting action of which also caused an additional supply of air through lateral supply pipes. These mantles were never a great success. The necessity of using air under pressure was a serious drawback; but the most important objection to them was that the surface of the platinum was slowly corroded by the burning gas, and though the mantles yielded a very good light at first, their luminosity rapidly decreased to a very low point.

In the Clamond mantle, a conical basket of threads of calcined magnesia was employed; being supported in a small platinum cage, point downwards. The flame was driven into it from an inverted burner above. These baskets were formed by moulding a paste of the hydrate and acetate of magnesia, mixed with water, into threads, which were then woven into basket-form and ignited. In this system, the gas and air were at first used under pressure; but in the later forms, the basket was converted into a mantle by supporting it with its apex upwards, and an ordinary burner of the bunsen type was used to heat it.

The above mentioned processes and researches really represent everything of importance that was done prior to Dr. Auer von Welsbach's great adaptation; the various attempts to improve the Drummond light, the efforts of Bourbouze, Wiesnegg, Popp, and Sellon to render the platinum mantle a success, and such publications as the much-quoted patent of Stokes Williams, having no real bearing on the subsequent introduction of the incandescent mantle.

Bunsen's laboratory at Heidelberg, which was the birthplace of the bunsen burner, also supplied the idea of the mantle in the form which has revolutionized our systems of lighting; as it was here that Welsbach pursued his studies and researches on the rare metals and their salts, which afterwards stood him in such good stead. The most generally credited story of his discovery is that, while boiling a solution containing salts of some of the rare metals, the liquid boiled over, and evaporating on the fibres at the ragged edge of a piece of asbestos card (which served to support the beaker, and round which the flame was lapping), endowed them with such luminosity as to attract Welsbach's attention, and that he then devised a method of preparing a mantle of the oxides of these metals that should fit the bunsen flame, and should be made up of sufficiently attenuated filaments to allow of the flame raising it to the necessary degree of incandescence. It is more likely, however, that, as the high power of incandescing possessed by the oxides covered in his first patent of 1885 were traditions in the laboratory from the work of Bahr and Bunsen, the application of the principle underlying Talbot's and Frankenstein's experiments to the formation of a practicable mantle from these salts, was in reality the great initial step in this matter.

Be this as it may, it is impossible to give Dr. Auer von Welsbach too much credit for having brought into a practical form odds and ends of knowledge which up to this period had been practically useless, and which after another seven years of work and experience have resulted in one of the most remarkable successes of modern times. In his 1885 patent, Welsbach protected the idea of making a mantle by saturating the cotton fabric and then burning off, using mixtures of the salts which he gives as 60 per cent. of zirconia or oxide of zirconium, 20 per cent. of oxide of lanthanum, and 20 per cent. of oxide of yttrium. The oxide of yttrium may be dispensed with, the composition being then 50 per cent. of oxide of zirconium and 50 per cent. of oxide of lanthanum. Instead of using the oxide of yttrium, ytterite earth, and instead of the oxide of lanthanum, cerite earth, containing no didymium and but little cerium, may be employed. The mantles made under this patent served the purpose of accustoming the public to the idea. But commercially they were a total failure, as the light they emitted hardly exceeded that which the Clamond basket has given, while they were far more fragile. A number of tests made between 1886 and 1889 showed the light emitted to vary from 3 to 6 candles per cubic foot of gas consumed, the higher value being rarely reached; while on making mantles with the purer materials obtainable at the present time, according to the prescriptions given in the 1885 patent, the results obtained are—

	Composition of Mantle. Per Cent.	Gas Consumed. Cubic Feet.	Illuminating Power. Candles.	Candles per Cubic Foot.
1.—Zirconia	60	5·4	12·9	2·4
Lanthana	20			
Yttria	20			
2.—Zirconia	50	5·5	9·4	1·7
Lanthana	50			

This shows that a good deal of the candle power of the earlier mantles was due to impurities present in the salts used, and also to the fact that the prescriptions were continually being varied in hope of improving the results, and that when obtainable thoria was used to replace the zirconia.

In 1886, Welsbach took out his second patent, which covered the use of thoria, either when used alone or mixed with zirconia, magnesia, yttria, erbia, neodidymia, lanthana, alumina, &c. It is evident from the text of the foreign patents which correspond with the English 1886 patent, that Welsbach had the impression that a pure thoria mantle had a very high power of emitting light; and that it was for this purpose that he patented it. In point of fact, however, if the thoria be pure it emits practically no light at all; but later experience showed that it had properties which rendered it the most important of the oxides used in mantle making, as its refractory nature gives a stability to the feeble structure that cannot be obtained by any other known body.

The thoria mantles made under the 1886 patent gave a service of 6 candles per cubic foot of gas consumed; but when now made with pure thoria as specified in the patent, they give a duty of less than 1 candle per cubic foot of gas, while the other mixtures specified in the patents give results which hardly come within the range of practical utility.

		Gas Consumed.	Light Emitted.	Candles per Cubic Foot.
1.—Thoria	3 parts	4·4	9·0	2·0
Magnesia	2 ,,			
2.—Thoria	1 part	4·5	15·0	3·3
Zirconia	1 ,,			
Yttria	1 ,,			
3.—Thoria	30 p. ct.	4·7	12·2	2·5
Zirconia	30 ,,			
Lanthana	40 ,,			
4.—Thoria	2 parts	4·5	12·2	2·7
Magnesia	1 ,,			
Lanthana	2 ,,			
5.—Thoria	3 ,,	4·0	3·6	0·9
Magnesia	1 ,,			
Alumina	1 ,,			

The use of ceria together with thoria, is mentioned in some of Welsbach's early foreign patents; but the exact date at which it was first realized that traces of ceria had the marvellous effect on the light-emissivity of the thoria mantle that we find in the mantles of to-day is not very clear. It is evident, however, that the advantage of the presence of small quantities of ceria was beginning to be realized in 1891, when Mr. W. Mackean, the Chemist of the English Welsbach Company, read a very interesting paper before the Society of Chemical Industry, and pointed out that ceria was by no means a disadvantage in small

quantities, as it added to the constancy of the illuminating power. He gave a table showing the influence of the presence of ceria in the lighting fluid; and also the influence upon the light which increasing quantities of ceria have. Thus, for instance, the ordinary lighting fluid contains 0·25 per cent. of ceria, and gives 25 candles for a consumption of 2·5 cubic feet of gas, or 10 candles per foot; but an increase in the percentage of ceria to 0·5, reduces this to 18 candles for 2·5 cubic feet. When 1 per cent. of ceria is added, a further reduction to 13·5 candles for 2·5 cubic feet is found; but while the candle power lost 43·2 per cent. in 1000 hours with the 0·25 per cent. of ceria, it only lost 12·6 per cent. in one experiment and 28 per cent. in another with 1 per cent. of ceria present in the original fluid. He also, in the same paper, gave the composition for a mantle furnishing a yellowish light—lanthana 40 per cent, thoria 28 per cent., zirconia 30 per cent., and ceria 2 per cent. This shows that at that period the use of small quantities of ceria in mantles containing thoria was by no means unknown.

About this date, also, mantles on the Continent began to show a marked improvement; and in 1891-92 it was reported that Welsbach had produced new mantles yielding as much as 16 and 17 candles per cubic foot of gas consumed. The same great improvement manifested itself in the English mantles; the cause of the great advance being made clear the following year by Mr. Moeller taking out the patent of 1893, in which he sought protection for thoria in combination with very small traces (not exceeding 1 or 2 per cent.) of the oxides of certain other rare metals—such as uranium, cerium, terbium, neodidymium, samarium, praxeodymium, yttrium, and lanthanum. The mantles of to-day nearly all consist of 99 per cent. of thoria and 1 per cent. of ceria, as, although several of the oxides mentioned in minute traces endow a non-luminous thoria mantle with the power of emitting light, yet ceria so far transcends the others in its capacity of not only exciting luminosity but of keeping up the illuminating power over a long period, that as far as present knowledge goes it is needless to look beyond it.

From this brief description of the growth of Welsbach's great discovery, it is clear that our present mantles are the outcome of three distinct stages of invention—

1.—The method of making the mantle and the use of the oxides of the rare earths.
2.—Using thoria instead of zirconia as the basis of the mantle.
3.—The effect of traces of other oxides on the light-emissivity of thoria.

At the period when Welsbach commenced his classical piece of technology, the rare earths had been studied by but few; and though there were several illustrious chemists—first and foremost among whom stood Bunsen—who had made a special study of them, and knew how to prepare them in a condition of absolute purity, it was with the commercial, and not the purely scientific, side of the question that Welsbach had to deal. The price of most of the constituents being almost prohibitive, the processes for purification, which necessitated a considerable loss of material, were not pushed to the point that can be done at the present time, with the enormously cheapened earths at our disposal; the result being that the candle power of the earlier mantles was often more influenced by the impurities present in the materials used than by the actual composition of the mantle. This was undoubtedly the case with the nitrate of thorium used in the manufacture of the mantles in the early nineties, which was made from thorite and orangite, and which contained besides thorium salts, cerium, lanthanum, yttrium, and neodidymium compounds in large traces.

The light given by these mantles having attracted attention, careful analyses were made; and it was found that the pure thoria gave practically no light, while directly the traces were added to it the high illuminating value of the mantle returned. Having found this, Welsbach applied for a German patent to protect mantles made with thoria containing 1 to 2 per cent. of ceria; but the patent was not granted.

Many experiments have been made in order to determine the effect of the percentage of ceria when added to thoria on the light-emissivity of the mantle; and the results vary in putting the highest light-emissivity at from 0·9 to 3 per cent. of ceria, the reason of this discrepancy being due to a number of small causes acting together. In order to get the maximum result, exact air adjustment is necessary, and traces of impurities must be very carefully eliminated. Under these conditions, the point of maximum emissivity may be stated as 99 per cent. thoria and 1 per cent. ceria. At this highest point, however, the mantle is peculiarly sensitive to air adjustment; and if this is not attended to in the most careful way, the results may vary between the limits indicated. Moreover, it is necessary that the mantle should have been most carefully treated—first with dilute alkali, then with dilute acid, and finally thoroughly washed with distilled water and dried under conditions which preclude the possibility of their being contaminated with dust.

If these conditions are observed, it is found that, starting with a pure thoria mantle giving practically no light, the candle power rapidly rises as traces of ceria are added to it, until the maximum is reached, when it again rapidly falls away with further increments of ceria. The colour of the light undergoes at the same time a very marked change, and acquires a yellowish tint which, with increasing quantities, becomes gradually of a reddish character. The narrow limit over which the highest light-emissivity exists, renders a careful proportioning of the liquid for soaking the mantle of the greatest importance.

Experiments have also been made in order to try the effect which additions of various proportions of ceria have upon the life of useful light emission which the mantle possesses; and these show that, with a Welsbach mantle made under the ordinary conditions of impregnating the cotton fabric with a solution of the nitrates of thorium and cerium, the higher the initial illuminating value, the more marked is the loss in light over a given space of time. In the ordinary burning of a commercial Welsbach mantle, it is generally found that the light increases for a certain period, and that then a steady fall in illuminating power takes place; the initial period of gain in light-emissivity most probably being due to the mantle shaping itself to the flame, while the gradual fall in power which takes place after that period has been completed is chiefly due to dust particles containing silica, which are drawn in over the surface of the mantle by the chimney draught, and which, fusing on the outside of the fine filaments, form silicates having a lower power of light-emissivity than the original oxides. This point will again be reverted to in the following lecture, where I shall have to show the important bearing which the form of the filaments composing the mantle has upon this power of keeping up its illuminating value. In the Welsbach mantles made during the past few months, the preliminary rise in illuminating power which used to take place in the first 100 to 120 hours has disappeared, and the fall seems to start at once; this being probably due to the mantle being seasoned—*i.e.*, shaped and heated for some time before being sent out.

Since the facts which I have brought before you with regard to the thoria-ceria mantle have been fully ascertained, innumerable attempts have been made to evade the patent under which the Welsbach mantle is manufactured; but so far these efforts have not been of much profit to any but the legal profession and the experts. Indeed, it may be stated that the only mantle which in England has had its position placed upon the same legal footing as the Welsbach, is the Sunlight, in which advantage was taken of the power which oxides of chromium have of exciting luminosity when superimposed on a structure of alumina. In some of the mantles which have been proposed, small quantities of acidulous bodies are added—such as silicic acid or the oxides of arsenic and antimony—with the view of converting a portion of the thoria into silicate, arseniate, &c.; but in no case that I have tested does the alteration improve the mantle either in life or light-emissivity.

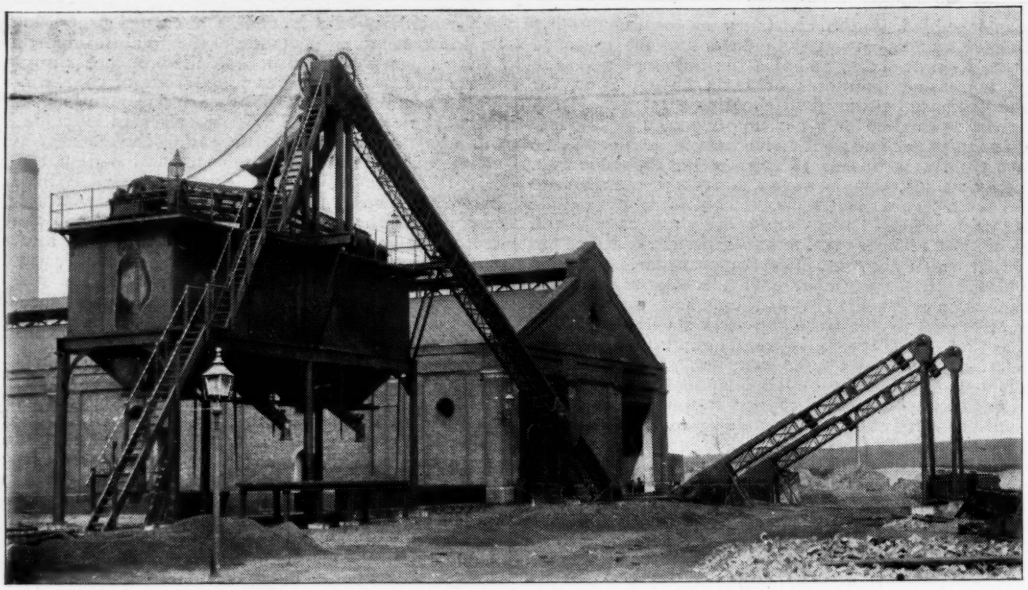
Another very popular method of making an alteration in the way of obtaining the mantle is to first produce a basis of thoria, and having got the fabric in thorium oxide, to coat it with a mixture of 99 per cent. thoria and 1 per cent. ceria. This modification of the process certainly seems to give an improvement in the mantle. In the Voelker mantle, a basis of thoria is produced which is then coated by dipping in a substance termed by the patentee "Voelkerite." This latter is made by fusing together a number of oxides in the electric furnace. The fused mass so obtained is then dissolved in the strongest nitric acid, and diluted with absolute alcohol to the necessary degree; and a very good mantle, having great lasting power, is thus produced. It is claimed that the process of fusing the material together in the electric furnace in some unexplained way alters the composition; but the true explanation is probably that all water of hydration is eliminated.

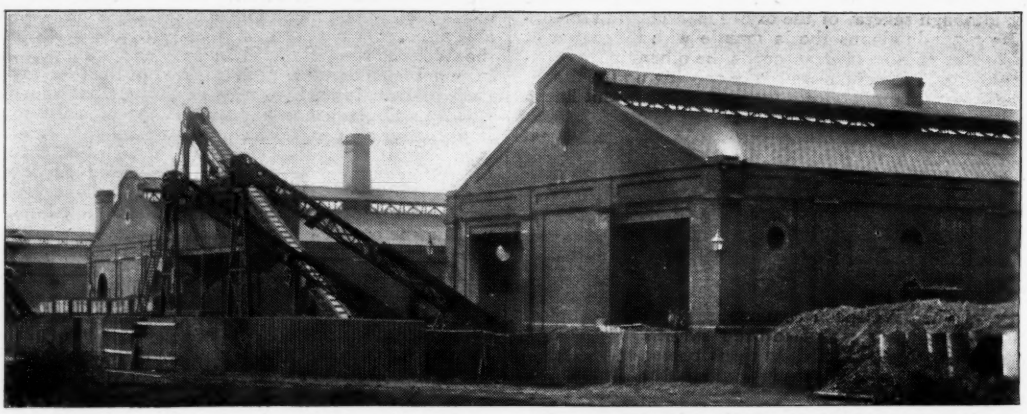
The Daylight mantle consists of a basis of thoria or thoria mixed with zirconia, which is then dipped in collodion containing a salt of cerium in solution; and on burning off the collodion, the ceria is left in a finely-divided condition on the surface of the thoria. There is no doubt that, in this way, a very high initial illuminating power is obtained; and I have seen mantles made on this principle which within a few hours of their ignition have given a total illuminating value of 100 candles, with a service of 24 to 25 candles per cubic foot. The Crown mantle, which is very largely adopted in Berlin, is of this description, and is produced by making a mantle of pure thoria from a fabric of ramie saturated with the nitrate, and then dipping the thoria basis in a mixture of 99 per cent. thoria and 1 per cent. ceria; the mantle so produced being of very considerable strength, and retaining its power of light-emissivity for a much longer period than the ordinary Welsbach mantle.

On the whole, the Welsbach monopoly has been of considerable advantage, as in the ingenuity exercised in attempting to circumvent the patent many experiments have been tried, and results obtained, which would not have been arrived at had the ordinary mixture and process been open to all users.

A careful observation of the Welsbach mantles in use shows that the light emitted by them is not of a constant quality, and that there are occasionally batches of mantles which give a distinctly greener light than others. This variation in the colour of the light emitted is, however, very often found to be a function of the temperature to which the mantle is heated; and where the temperature and light-emissivity are highest, one often finds a greenish tint appearing which, with a less well-arranged burner, appears as a white light of a lower quality.

Many attempts have been made to compare the amount of light belonging to the different portions of the spectrum in the light emitted by the mantle; and in the following table, published by Munsterberg, the proportion of rays of different colours emitted by the Welsbach incandescent mantle is compared with





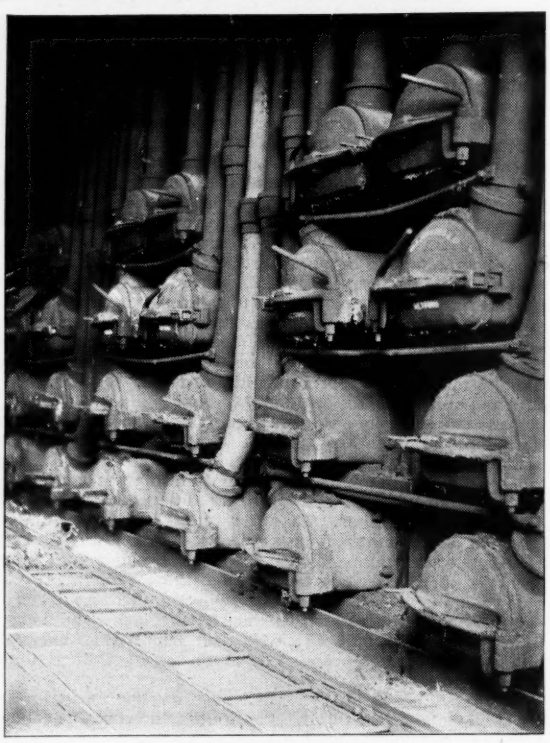
the number of the same rays in sunlight (taken as unity) and with other illuminants:—

Colour in Spectrum.	Electricity.		Coal Gas.		Acetylene.	
	Arc.	Incandescent.	Ordinary.	Welsbach.	Alone.	With Air.
Red . .	2·09	1·48	4·07	0·37	1·83	1·03
Yellow .	1·00	1·00	1·00	0·90	1·02	1·02
Green . .	0·99	0·62	0·47	4·30	0·76	0·71
Blue . .	0·87	0·91	1·27	0·74	1·94	1·46
Violet . .	1·03	0·17	0·15	0·83	1·07	1·07

The value of the table is, however, a good deal discounted by the conditions under which the experiments were made not being stated.

THE DE BROUWER COKE CONVEYING AND ELEVATING PLANT AT THE CRYSTAL PALACE GAS-WORKS.

The description which we published on Jan. 23 last of the De Brouwer coke conveying and elevating plant at the Crystal Palace District Gas Company's works has aroused considerable interest in the gas profession. Being the first installation of the system in the country, there is a natural desire to know something as to the experience of its working; and as far as it is possible after only about three months' active service, we will endeavour to gratify our readers. Before doing so, however, reference may be made to the three photographic views of portions of the plant which we have pleasure in reproducing. One of them shows a section of the conveyor in the floor of the retort-house. It clearly depicts the simplicity of its construction—consisting as it does merely of a trough and a transmitting chain, the two lines of which are kept apart as shown by round iron stay-bars. In the other two illustrations, we have general views of the plant which deals with the coke outside the house. The larger one gives a very clear view of the elevating and screening plant, storage hopper, and loading arrangements; while the smaller one is chiefly interesting for the view it gives of the surface of the elevator up which the coke ascends to the storage hopper. The two smaller elevators, or sloping continuations of the conveyors in the retort-house, will only be used for the



purpose of dealing with any surplus coke there may be; but so far as can be seen, their duties will be very light. The minute description of the plant already published renders unnecessary any further allusion to the photographs.

By the courtesy of Mr. Sydney Y. Shoubridge, the Gas Company's Engineer, we last week had the privilege of seeing the plant in operation under normal working conditions. It was

brought into use almost immediately after the publication of our previous article; and it has since been performing its duty in a manner that has given every satisfaction. Its operation at the time of our visit was proceeding with a perfectness that was pleasant to behold; and therefore we have the best of reasons for believing that the credit it has earned for itself up to the present will be enhanced as time goes on. The plant has been found to effect a considerable saving in labour as compared with the old system of wheeling the coke out in barrows. To do the work by hand in this one house, 31 men were required in twenty-four hours; while now the same work is accomplished, by the aid of the machinery, with only six men. There is, in fact, so far a saving of about 5d. per ton of coal carbonized under the altered conditions, after making due allowance for interest, sinking fund, and wear and tear.

On one point only, it is impossible, owing to the shortness of time the plant has been in use, to speak with strict certainty, and that is as to its durability. But, as stated in the previous article, the manufacturers, Messrs. Jenkins and Co., have made certain important improvements on the original method of construction to secure a good character for the plant in this regard; and from what we saw last week of its easy and smooth operations, together with the inquiries made, we think we may say there is every assurance that time will prove that the confidence of Mr. Shoubridge in this respect has not been misplaced. In an examination of the whole of the plant, we failed to detect rattling, friction, or strain in any part; the whole was running with the regularity and smoothness of clockwork, and with exceedingly little noise. This all gives promise of long life. As to the other claims which Messrs. Jenkins and Co. put forward in commendation of this type of plant, as set forth in the descriptive article, our observations convince us that they are fully substantiated. Beyond this it is unnecessary to say more.

THE MANUFACTURE AND APPLICATION OF WATER GAS.

By Carl Dellwik.

At last week's Meeting of the Iron and Steel Institute, Mr. Carl Dellwik read a paper bearing the above title; and in view of the specific references to the Dellwik plant made by Professor Lewes in his lecture the previous week before the Institution of Gas Engineers, some considerable extracts from Mr. Dellwik's paper will be of interest.

After a few introductory remarks, the author said: My present object is to explain the theory on which the Dellwik-Fleischer process is based, and the results obtained in practice, as well as to give a short account of some of the applications which have been made for manufacturing purposes.

The value of a gas for industrial purposes depends mainly on two considerations: (1) Its adaptability for each specific purpose; and (2) its price as compared to other fuels capable of being used, though perhaps less advantageous from a purely technical point of view.

Speaking in general terms, there can be little doubt that the higher the quality of a gas is, the more readily it may be adapted for the great variety of purposes for which gaseous fuel is used in modern manufacturing. So, for instance, ordinary producer gas, of which 55 to 60 per cent. consists of incombustible elements, is quite useless for certain purposes where coal gas and water gas have proved to be excellent sources of heat. On the other hand, coal gas, by reason of its high price, the complicated and costly appliances required for its production, and other disadvantages, is practically excluded from use on a large scale for manufacturing purposes. As regards price, the same objection, though in a less degree, until recently held good against water gas, except, as has already been mentioned, in special cases where the economy of its application was so great as to counterbalance the waste of energy in its production.

For general manufacturing on a large scale, producer or Siemens gas has, therefore, remained unrivalled, as offering the cheapest means of heating large furnaces. It is, however, evident that, given the possibility of converting fuel with the same degree of economy into a gas of a higher calorific power than producer gas, such gas cannot fail to obtain a vast sphere of utility. Water gas being all combustible, having a very high flame temperature, and per volume more than twice the calorific power of producer gas, in all respects fulfils the technical requirements as regards quality.

Before proceeding to an account of practical results, I will enter into a short theoretical comparison between producer gas, water gas manufactured by what I will call the "old" processes, and water gas manufactured by the Dellwik-Fleischer process.

When 1 lb. of carbon is burnt to carbon dioxide, it develops 8080 thermal units (°C.); and when burnt to carbon monoxide, it gives off only 2400 thermal units. As the Siemens process consists in burning the carbon to carbon monoxide, it follows that the gas produced from 1 lb. of carbon contains 8080 − 2400 = 5680 thermal units, corresponding to a utilization of about 70 per cent. of the heating value of the solid carbon. This figure, therefore, roughly represents the maximum theoretically possible utilization in the cooled gas of the heating value of the fuel, when losses from radiation and other sources are not taken into account.

The process of water-gas manufacture consists in the alternate heating of a bed of fuel to incandescence by means of an air-blast, and the subsequent decomposition of steam in contact with the fuel thus heated, until the decrease in temperature necessitates a new period of heating. In all processes hitherto in use, both of these periods (of water-gas making and of blowing) have yielded combustible products—each containing a portion of the heating value of the fuel. The generators may have varied in form, using an air-blast, or a forced draught, or a down draught for the periods of heating or blows; but the chemical reaction has always been the same—viz., a combustion to carbon monoxide—so that the gas leaving the bed of fuel in the generator has consisted principally of carbon monoxide and nitrogen. The most important problem in the construction of a water-gas plant on a large scale on this principle has, therefore, been to find suitable employment for this producer gas, which contained the greater portion of the heat of the fuel. The difficulty of doing this, and especially the difficulty of utilizing it in the same proportion as it was generated, has, in fact, formed one of the most serious obstacles against the introduction of water gas. Various devices have been resorted to for the purpose of utilizing the producer gas for increasing the yield of the more valuable product, water gas—such as preheating of the air or steam, or both, for the water-gas generator. All such arrangements have, however, proved more or less ineffective, besides complicating the apparatus; and the ordinary practice in the production of "blue" water gas has, therefore, been simply to use the producer gas to generate the steam for the water-gas manufacture. But even this has by no means always been done; and the insufficient utilization of the fuel has been such as to effectually prevent the general introduction of water gas.

As the chemical reaction in the generation of the water gas is always the same, it is evident that the condition for an economical production of water gas is to effect the greatest possible utilization during the blows of the heat contained in the fuel, and the means to accomplish this is to produce a complete combustion in the generator. Practical results have proved that it is possible by very simple means to establish such conditions in the generator that, during the blows, a practically complete combustion to carbon dioxide is obtained within the bed of fuel to be heated, while at the same time conditions favourable to the water-gas making are maintained.

This, then, is the radical difference between the "old" processes and the one which I have originated—that, while in the former the gas leaving the generator during the "blow" contains principally carbon monoxide in addition to the inevitable nitrogen, in the latter it consists principally of carbon dioxide and nitrogen. Given this difference in principle, we will now proceed to inquire into the effect of these different methods.

If we look at the chemical reaction in the formation of water gas, we find that 18 lbs. of steam, consisting of 2 lbs. of hydrogen and 16 lbs. of oxygen, require for their decomposition 2 × 28,780 = 57,560 thermal units. The 16 lbs. of oxygen combine with 12 lbs. of carbon to form 28 lbs. of carbon monoxide, which mixed with the 2 lbs. of hydrogen forms 30 lbs. = 753·4 cubic feet of water gas. The heat developed by the formation of the carbon monoxide is 12 × 2400 = 28,800 thermal units; thus leaving a balance of 57,560 − 28,800 = 28,760 thermal units, which must be replaced by combustion of carbon during the blows. Assuming, then, as is approximately the case in practice, that the blow-gas leaves the generator at a temperature of 700° C., we find—

	"Old" Methods.	Dellwik Method.
1 lb. of carbon requires for combustion	to $CO - \frac{16}{12}$ lbs. O.	to $CO_2 - \frac{32}{12}$ lbs. O.
This oxygen is accompanied by	4·32 lbs. N.	8·64 lbs. N.
And the products of combustion carry with them at 700° C.	1136 thermal units.	2092 thermal units.
The heat of combustion of 1 lb. of carbon is.	2400 thermal units.	8080 thermal units.
The balance available for heating the fuel is therefore	2400 − 1136 = 1264 thermal units	8080 − 2092 = 5988 thermal units.
To fill the before-mentioned balance of 28,760 thermal units at the production of 30 lbs. of gas, there must then be burnt	$\frac{28,760}{\cdot1264}$ = 22·75 lbs. C.	$\frac{28·760}{5988}$ = 4·83 lbs. C.
Not counting the heat lost by radiation and other causes, there are then required for the production of 30 lbs. = 753 cubic feet of water gas	12 + 22·75 = 34·75 lbs. C.	12 + 4·83 = 16·83 lbs. C.
Or per 1 lb. of carbon are obtained	21·7 cubic feet water gas.	44·7 cubic feet water gas.
As water gas of theoretical composition contains 167 thermal units per cubic foot, there are utilized in the water gas from 1 lb. of carbon	3627 thermal units = 44·8 per cent. of the heating value of the C.	7465 thermal units = 92·5 per cent. of the heating value of the C.

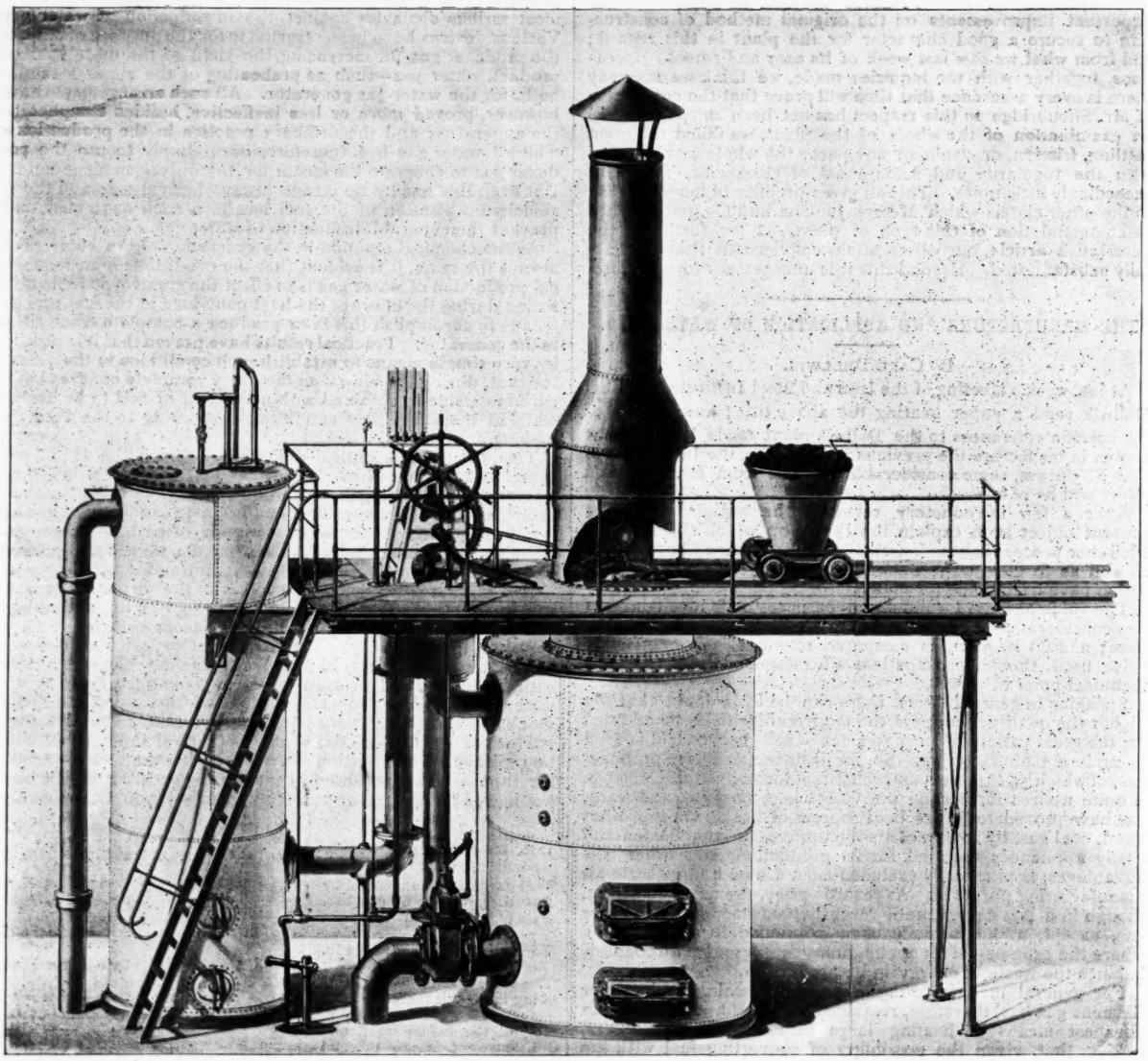
The practical working of these three different processes—for Siemens gas and water gas—is, of course, somewhat at variance with the theoretical calculations. In all of them there are

losses from radiation, &c.; and in all of them there is formed a certain amount of carbon dioxide, which is, however, to some extent compensated for by an equivalent development of hydrogen, which also tends to increase the volume. On the other hand, there is a gain from dry distillation when bituminous fuel is used. In the Siemens process, there is a further gain by the decomposition of steam in the generator at the expense of the heat developed in burning the fuel to carbon monoxide, so that its practical efficiency may be estimated at from 60 to 72 per cent.

In the old water-gas processes the producer gas formed during the "blows" is amply sufficient for generating the steam needed for the process, though, as before mentioned, it has by no means always been so used. When a combustion to carbon dioxide is effected in the generator, this advantage is, of course, lost; the waste heat being only sufficient for preheating the feed-water for the boiler. It is, therefore, necessary in this case to add for boiler fuel 12 to 15 per cent. to the fuel used in the generator. This reduces the theoretical quantity of gas obtainable from 12 lbs. of carbon to 656 cubic feet; and the possible utilization of the heating value of the fuel to about 80 per cent.

The water gas obtained in practice is of somewhat different composition from that theoretically calculated; and its calorific power is about 158 thermal units per cubic foot. If the coke averages 7000 thermal units per pound, then the utilization of the heat by these processes is 28 to 36 per cent. It then remains to ascertain how nearly the Dellwik-Fleischer process in practice approaches the theoretical computation. It is now nearly three years ago since the preliminary experiments were completed; and some of the recognized authorities of the gas industry were invited to examine into the results obtained. The first to accept such an invitation was Professor Vivian B. Lewes, of London. He has summed up the result of his test as follows:—

One thousand cubic feet of water gas, containing 15 lbs. of carbon, are obtained by a total expenditure of 29 lbs. of carbon; so that over 51 per cent. of the carbon is obtained in the gaseous form, while the expenditure of the other 49 per cent. results in the hydrogen of the water gas. The coke used in the experiments made contained 57·56 per cent. of carbon, or 1961·3 lbs. per ton, equal to 15,876,307 thermal units (° C.); and this amount yielded 77,241 cubic feet of water gas. The specific gravity, as taken by the Lux balance, was ·5365; and its gross calorific value, as determined in Junkers calorimeter, was 4089 thermal units. Hence the calorific value of the water gas from a ton of coke was 13,033,059·8 thermal units, or over 82 per cent. of the heating value of the total coke used in both generator and boiler. From this calculation 20 per cent. of the coke has been taken as used for raising steam; but in a large installation this figure could be reduced, and the percentage of the total heating value of the coke obtained in the gas slightly raised. The labour needed will be less than with the ordinary process, as less fuel has to be handled.



Other tests, made by Professor Bunte, of Karlsruhe, Professor Lunge, of Zurich, Dr. Leybold, of Hamburg, and others, have given similar results. The most trustworthy figures for continued work have been obtained from an installation at the Corporation Gas-Works at Königsberg, in Prussia, where an average yield of 38·44 to 39·72 cubic feet of water gas are obtained per pound of carbon contained in the coke charged into the generator. This corresponds to a utilization of 75·2 to 77·7 per cent. of the calorific value of the fuel. At another gas plant the tests showed a yield of 41·6 cubic feet per pound of carbon, or an efficiency of 81·3 per cent.

The method of working the generators illustrates the difference from the old methods. In the latter, the duration of the blow was from 10 to 15 minutes; while the water gas was made during the following 4 to 5 minutes. In the Dellwik generators the blow lasts only 1½ to 2 minutes, while water gas is subsequently generated for 8 to 12 minutes. During the blow, the combustion continues throughout the entire depth of the fuel; and the whole bed of fuel is thus raised to an even high temperature—enabling the periods of water-gas production to be considerably lengthened without any deteriorating effect on the quality of the water gas.

The illustration shows the appearance of a generator. The surrounding sheet-iron shell is lined with fire-brick. On a level with the clinkering-doors is a grate supporting the fuel; and below are ash-doors for removal of the ashes. The air enters through the blast-valve; and the blow-gas leaves the generator through the central stack-valve, through which the fuel is also charged by means of a small coke-waggon. There is one water-gas outlet at the top of the generator, and one below the grate—both connected with a three-way valve, through which the gas passes on its way to the scrubber. The gas-pipe is sealed with water in the bottom of the scrubber, where the gas is cooled, and

all dust washed out by the water running through the coke with which the scrubber is filled. From the scrubber, the gas passes on to a small holder, which equalizes the flow of gas to the place of consumption. There is a steam-pipe leading into the bottom, and one to the top of the generator.

The method of working is as follows: A fire having been built on the grate, and the generator filled to the proper level with coke, the blast-valve is opened; and the fuel is raised to a high degree of incandescence in a few minutes. Then one of the gas-outlets (the upper one, for instance) is opened; the blast and stack valves being simultaneously closed by the gearing on the working stage. Steam is then admitted to the bottom of the generator; and, passing up through the bed of incandescent coke, it is decomposed—forming water gas. A set of water-gauges and a test-flame indicate the condition of the apparatus and the quality of the gas. When the temperature of the fuel has sunk below the suitable point, so that carbon dioxide begins to form in a larger proportion, the steam is shut off and the stack valve opened—the gas-valve being simultaneously closed. The blast-valve is then opened for another blow of 1½ to 2 minutes. For the next period of gas making, the lower gas-outlet is opened, and steam admitted above the fuel. By thus reversing the direction of the gas making, the temperature of the fuel is equalized—causing less wear on the brick-lining at any one point. The greater part of the coke being consumed by the action of the steam, the incombustible portions of the coke to a large extent disintegrate, and fall through the grate as ash; while the clinkers on the grate are brittle and easily removed.

From the results which I have already quoted, it is evident that by this process there is no difficulty in obtaining an efficiency rather higher than that usual in the Siemens process, and twice as high as that of the older water-gas processes. It is unnecessary to make any comparison with the latter as to price. But in regard to the former, the thermal efficiency is so nearly equal that the advantage of using one or the other of the two gases must almost entirely depend on the relative advantages they offer for practical use. The question thus becomes one of quality of the product obtained.

Siemens gas, even of the best quality, contains at least 56 to 60 per cent. of incombustible gas (CO_2 and N). The gas will, therefore, scarcely burn when cold; and it is necessary to pre-heat both the gas and the air for combustion to obtain a high temperature. For this reason Siemens gas cannot advantageously be used for small furnaces, and is impossible for any purpose where an open flame is required—as, for instance, for welding, brazing, or soldering. On account of its great volume and low calorific value, it is also not adapted for storage in gas-holders, or for being conducted to any considerable distance from the generator. Another important disadvantage is that it cannot easily be purified from the sulphur contained in it. Its utility is, in fact, limited to large furnaces with regenerative firing. But it must be remembered that, though any required temperature may be obtained, this must necessarily be done at a considerable loss of heat; for the reason that all the non-combustible portions of the gas must be raised to the temperature of the flame, and a high heat can be reached only after protracted firing.

Water gas possesses quite different properties. Its composition averages—

	Per Cent.
Hydrogen	51·0
Carbonic oxide	42·0
Marsh gas	0·5
Carbonic dioxide	4·0
Nitrogen	2·5
Total	100 0

Practically, it is therefore all combustible. Its flame temperature is such that a wire of commercial platinum melts in the flame from an ordinary gas-burner. Its heating power is, per volume, two-and-a-half times that of producer gas; and it can, therefore, be stored in a holder and conducted to any required distance with the same facility as coal gas. It can be used for all purposes, being equally efficient for the small glass-blowing lamps for the manufacture of electric glow-lamps as for the melting of steel in an open-hearth furnace. It is applicable for all heating stoves and furnaces now so extensively used for coal gas, and for many other purposes for which coal gas is too high priced to be used. Water gas can further be obtained absolutely pure, as the sulphur is contained in the form of sulphuretted hydrogen, which can easily be eliminated by passing the gas through purifiers filled with hydrate of iron; and it then consists almost entirely of hydrogen and carbonic oxide.

Leaving the method of manufacture, and the properties of water gas, the author turned to the results obtained by its application for practical purposes, in open-hearth steel melting, crucible steel melting, the welding of iron plates, &c. He then proceeded: The conversion of all the fuel into gaseous form at one place, and the distribution from this central station of the gas to the different furnaces and other places of consumption, is a principle which ought to recommend itself in all industrial establishments where large quantities of fuel are used, which will otherwise have to be carted around to a number of different places—involving labour and waste. Such a central gas-producing plant would also supply the cheapest means of generating power. For one-horse power are required 30 to 35 cubic feet of water gas per hour; and, as has already been shown, this quantity of gas is produced from less than 1 lb. of coke. The efficiency of gas-engines of small size is very nearly the same as that of large ones, which is not the case with steam-engines; and a system of water-gas plant and gas-engines, therefore, allows of a distribution of power far cheaper than is possible with steam-engines, and elaborate transmissions with shafts and belts. In addition, lighting by incandescent water-gas burners is the cheapest illuminant obtainable, and offers also other advantages over the same kind of lighting with coal gas, as the flames burn more steadily, and the mantles can be made stronger. Some installations of "blue" water gas for general distribution have been made on the Continent; and the results have proved very satisfactory.

I have earlier referred to the introduction of carburetted water gas for general distribution as an admixture with coal gas. This system has met with a great deal of favour during some years past; but it lately labours under the drawback of advanced prices of oil. On the Continent, a high duty on petroleum has practically prohibited water gas enriched with this material. But at the present time the price of benzol has gone down in such manner as to make it a very cheap enricher; and a number of plants on the Dellwik-Fleischer system with benzol enrichment have been built, or are being built, as auxiliary to coal-gas works.

These examples of the general utility of water gas, when made by the present economical process, might easily be multiplied; but doing so would, to a great extent, mean repeating the qualities which make it so desirable in the instances I have specially mentioned.

CORRESPONDENCE.

[*We are not responsible for the opinions expressed by correspondents.*]

Mr. Carpenter's Paper on Inclined Retorts.

Sir,—I send you herewith my reply to the discussion on my paper, on inclined retorts at Bankside. It only deals with the kernel of the matter; and, as regards mechanical details, my reply would simply be a reiteration of the wording of the paper.

May 14, 1900. C. C. Carpenter.

[Enclosure.]

A well-known engineer who had wholly adopted this method of carbonizing said to me significantly some time afterwards: "Well! you burn your boats when you put up inclined retorts." My paper was not written for those who have burnt their boats, but for others who, hesitating to follow suit, are anxious not to burn their fingers as well. With the Bankside plant, I do not claim to have a perfect solution of the labour-saving part of the problem. But what I do claim to have done is to have worked inclined retorts under, from the gas-making point of view, the most favourable circumstances—viz., light, thin, and regular charges, burnt off with regular and constant heats, and to have proved conclusively that success or failure of the system depends first and foremost upon the suitability of the coal. Other reasons have been given for the want of success stated—viz., retorts too small, and the charging arrangements imperfect. As regards the first, if a retort 13 inches high, 24 inches wide, and 20 feet long is not suitable for burning off 6 cwt. of coal, I should like to know why. With respect to the second reason, the Salford arrangement is in use at the Old Kent Road works, and with no greater success; selected coal having to be used there also. As regards mixing the coal, if gas making is to depend upon this operation, then I pity the gas maker, unless his supply is on a very different footing to that of London. We are told that perfection does not exist in Nature. Some installations of inclined retorts, however, appear to approach very nearly thereto. Under such circumstances, it is a little disappointing to have to confess that the future extensions of the South Metropolitan Gas Company will be with stoking machinery and "horizontals."

The Paris Exhibition.

Sir,—There are few people who have not, in the course of their childhood, had the advantages of early rising impressed upon them by the striking example of the matutinal bird and the worm. However useful the habit of being astir betimes may have been found by the bird, in enabling it to secure its first meal, it is certainly not valuable to the technician in helping him to obtain mental *pabulum* by paying an early visit to the Paris Exhibition. It was acknowledged that on the opening day the Exhibition was very far from being complete; and though a great deal has been done in the month which has since elapsed, much still remains to be accomplished. However, by the time the members of the Gas Institute arrive in the City of Light, there will be something better for them to see than there is at present—that is to say, in their special department. For the moment, packing-cases are much in evidence, scaffolding is still up, and workmen are busily engaged in putting the finishing touches to buildings, and in evolving order out of chaos. While dust and dirt are about, exhibitors naturally decline to show their goods. A large number of those which are in position are consequently covered, and others are still reposing in the wood. Now, although one is able, according to the classic writer, to judge of Hercules by the size of his foot, and although the late Professor Owen could, from a very small piece of bone, construct an entire animal of the antediluvian period, it would have puzzled both classic and naturalist, even with the aid of the Röntgen rays, to get an idea of what an exhibit would be when on view by a glimpse at its constituent parts in a package.

Even now, however, there is much to be seen, though it is somewhat

difficult to get at. The pedestrian encounters heaps of builders' rubbish, workmen with an excess of plaster of paris about them are apt to come in too close proximity to the visitor's coat, carts delivering goods obstruct the way, the flooring is up, and there is consequently much impediment to comfortable locomotion. This condition of things obtains, for the most part, in the portion of the Exhibition devoted to the heavy goods. Where the lighter ones—those more easily handled—are on view, something like order prevails. Here it is that one sees the most visitors. And even now they come in fairly good numbers—about 82,000 having entered the Exhibition between ten in the morning and closing-time on Thursday. The work of completion is being pushed on with vigour; and to-day the Norwegian and United States Palaces in the Rue des Nations have been formally inaugurated. The finishing touch may probably not have been everywhere put on by the time the members of the Institute arrive; but they will nevertheless see plenty to well repay them for their visit. Apart from the exhibits with which they are specially concerned, there is at present upon the banks of the Seine such a show as has never before been witnessed; and it should certainly be seen by all who can do so. Those who find a sameness in great exhibitions will discover that this one presents some highly attractive features; and, moreover, the city itself has its almost irresistible charms. Gas managers are called upon, in the discharge of their daily duties, to "live laborious days," especially when they are reduced to the last ton of coal, or when a tank-waggon of oil has been left for days on a siding when it was urgently needed. This is no reason, however, why they should "scorn delights." On the contrary, it should be a justification for their occasionally tasting them. Let them, therefore, visit Paris, and see what she has to offer.

If for no other reason, they should come over to see the marvellous display of lighting which the Paris Gas Company have carried out on the Champ de Mars. The area covered extends from the Trocadero Palace to the Cascade in front of the Palace of Electricity—a good three-quarters of a mile, and about 150 yards broad in the narrowest part. On this and some of the adjacent avenues, the Company have put up from 1000 to 1100 lamps, fitted with Auer and Denayrouze burners, supplied with compressed gas. By the use of from 4000 to 4500 mantles with burners consuming from 9 to 12½ cubic feet of gas per hour—a total of from 43,000 to 60,000 cubic feet—the vast space is lighted up with the brightness of day. The lamps, which are of elegant pattern, are on single columns, and also mounted in groups of three and five. The last-named are on short pillars, rising from a solid stone base. Some of the large globe-shaped lamps on single columns are fitted with clusters of ten or twelve burners; and the volume of light emitted is perfectly dazzling in brilliancy. Standing at the foot of the steps of the Trocadero, and looking across the Seine in the direction of the Eiffel Tower, there is presented to the beholder a perfect sea of light, which makes the electric lamps on the Tower "pale their ineffectual fires." The Paris Gas Company scored a point by securing this area for a display of their powers; and they have not failed to make good use of their opportunity. It is a superb piece of lighting, which will delight the heart of every gas manager who witnesses it.

Paris, May 12, 1900. AN EARLY VISITOR.

Progress in Gas Matters.

SIR,—The interesting paper read by Dr. Colman at the meeting of the Institution of Gas Engineers marks further progress towards a knowledge of the value of coal gases of different illuminating powers. The fact brought out in Table 1B in the appendix to his paper—viz., that the gases lowest in illuminating power give the highest heating values—appeared to impress the majority of those present at the meeting as a startling refutation of views which they had previously entertained. No attempt, however, was made, either by Dr. Colman or by those who took part in the discussion, to explain what, apparently, was considered a phenomenon bordering on the mysterious. The explanation is not far to seek. In my opinion, it is to be found in the fact that the actinic or chemical rays of the flame are in greater proportion than the heat rays in the higher illuminating power gases than they are in the lower. It is this same fact that accounts for the lower diffusive quality of the electric light as compared with gas. It also goes a long way towards accounting for the difference which is now generally admitted to exist between the illuminating power of the laboratory testing-flame and the illuminating effect of the same gas in practice.

In this connection, it is interesting to see (by the report of a recent meeting), that even the Scotch gas managers are coming round to the view that 25-candle gas is a mistake, and that a much lower illuminating power gas—even as low as 16 candles—is more desirable in every way. Really, our friends in the North must take care. A long drop is good under some circumstances; but it is apt to have a neck-breaking effect, and we should be very sorry to see any of our Scotch friends come to grief.

The lecture by Professor Lewes at the Institution meeting should bear fruit in the near future. The subject last dealt with by him in the lecture—viz., the mixing of water gas with coal gas in the retort, and the removal of the gases therefrom at an accelerated speed—is of great interest. I fear, however, that the means he suggests for accomplishing the object proposed (the insertion of a pipe within the retort for the conveyance of the water gas) is impracticable. The temperature of the retort offers a bar to the use of any less refractory metal than platinum, and the cost of that is prohibitive. A channel might possibly be moulded in the crown of the retort to answer the purpose. Professor Lewes's method could be applied without difficulty to single retort-stacks where the back-ends of the retorts are closed by a lid; the water gas being driven in at that end. With inclined retorts, also, the water gas could be supplied at the charging mouthpiece. So with horizontal through retorts, all that is necessary is to dispense with one of the ascension-pipes, and force the water gas in at the blank end.

Manchester, May 9, 1900. THOMAS NEWBIGGING.

The Directors of the West Middlesex Water Company recommend a dividend, for the half year to March 31, at the rate of 5 per cent. on the consolidated stock.

PARLIAMENTARY INTELLIGENCE.

Gleanings from the Committee Rooms.

As last week's "JOURNAL" was going to press, we were able to insert the bare announcement that the portable photometer section of the London County Council Bill had been rejected by Mr. Oldroyd's Committee; and the intelligence, we know, has been received with gratification far beyond the limits of the area which would have been affected by the Bill. In the Committee room there was quite a manifestation of relief on the side of the Companies when the Chairman made it known that the suggested imposition of what would have been an unfair, additional burden did not commend itself to him and his colleagues; while the radiance of the countenances of those who had been backing up the Bill showed a sudden diminution of several points in candle power—tested optically, and not by the portable photometer. To them the decision came as a great surprise. They had been very confident of success from the first; and really the sensational evidence which they were able to produce at the outset was of the character which might have weighed the scales down in favour of the promoters had the Committee been composed of men who had no care to dip beneath the surface of what was laid before them. But fortunately the members of Mr. Oldroyd's Committee are not of that order. They took a deep and intelligent interest in the smallest details of this essentially highly technical subject, and mastered them with a delightful promptitude and adroitness. This was conspicuously noticeable even during the first hours of the hearing of the promoters' case; and it gave hope to those who were called upon to defend themselves and their customers' interests and pockets. It was a keenly fought contest; but strength and reason were on the side of the defenders. Victory, however, has only been secured at great expense, which the gas consumers and the ratepayers, who had not had a voice in the matter, will have to bear directly or indirectly. No evidence was submitted to show that the consumers were dissatisfied with the quality of the gas, or that there was any demand outside Spring Gardens for a more critical testing. The County Council stood entirely alone, and were not supported in the Committee room by any other Metropolitan authority. The proposals had their origin entirely in the brain of one chemist; and he succeeded in bringing a few others of his own profession to see virtue in them. Outside this limited circle, only a single practical Gas Engineer (though he was not the only one whose services were sought) came forward to speak in favour. The proposals unfortunately were just of that oppressive type which the preponderating section of the County Council in their rabid antagonism to vested interests take delight in; and so they fostered them. They have had their fling at the Gas Companies, but others have to pay.

The last day's proceedings on the Bill were not by any means the least productive of influential evidence. That given on previous days in opposition was good; but in some respects this was even better. Much of it was composed of such incontestable matter that even Mr. Worsley Taylor, with all his keen-wittedness and power of dissection, could not make any appreciable impression on it. The case of the South Metropolitan Gas Company was continued by the examination of three witnesses; Mr. C. C. Carpenter, the Company's Chief Engineer, being the first. He was perfectly frank and decisive in his statements. Dealing with the period covered by Mr. Dibdin's tests—1884-97—in which the gas was alleged to have steadily depreciated in quality, he showed how in those years improvements had been effected in the system of carbonizing, by which the production of gas was more regular and uniform than formerly. But even now, he admitted, gas could not be manufactured of absolutely uniform quality. He put in a table showing for the fourteen years the gas sold per ton of coal, and the illuminating power returned by the official tests, and by the portable photometer. It will be seen that the figures disclose an almost perfect equality in the gas sold per ton and in the official returns as to illuminating power over that long period; but there is a gradual, consistent depreciation in the returns of the portable photometer, which can only be taken as indicating a growing feebleness during that period in one of three directions—in the gas, the portable photometer, or the operator. That is was not in the gas, the official tests clearly prove. Mr. R. O. Paterson followed; and what he had to say regarding his investigations into the effects of temperature and moisture on the examination of gas may be read with profit. Then there was quite a little flutter of excitement among those who were "in the know" when Mr. Henry Woodall went into the box to rub a little of the gloss off the evidence of Mr. Isaac Carr, who was the only Gas Engineer who had appeared to support the Bill. Mr. Woodall related how, with two other gentlemen, he had been down to Widnes armed with the infallible portable photometer, and how for four days they had made a series of tests suggested by Mr. Carr's assertion that he was able, and had for the past five years, supplied a gas of 18½-candle power, without substantial diminution, throughout his district. Mr. Woodall's tests with the portable photometer showed results varying between 15·96 and 12·79 candles. Mr. Worsley Taylor's only explanation was that Mr. Carr during that time was "knocking his gas about" for experimental purposes, which Mr. Balfour Browne characterized as merely "a suggestion" on the learned Counsel's part.

While speaking of Mr. Carr's evidence, there is a little discrepancy in other figures to which we do not think attention has been called. He stated that his average production of gas was 10,000 cubic feet per ton of coal, that he uses 24,000 tons, and that his make of gas is 225 millions. According to these figures, he is astray to the extent of either 15 million cubic feet of gas or 1500 tons of coal, or his make is not 10,000 cubic feet per ton. Which is it? Evidence before a Parliamentary Committee should certainly be a little more precise than this.

The South Metropolitan Company's case was concluded by Mr. Balfour Browne in a neatly pointed address; and it was followed by an appeal to the Committee by Mr. Littler for a due recognition of the rights of the City Corporation in the event of the Bill being passed. Then the opposition of the Commercial Gas Company was proceeded with; Mr. H. E. Jones, the Engineer, repudiating emphatically the sinister inferences and suggestions underlying the case put forward by the promoters. "Impracticable, unreliable, and unjust" were the epithets used by Dr. Odling in

describing the proposals of the Bill; and Mr. William Sugg, than whom few can speak with more mature experience, showed that the terms used by the learned Doctor were none too harsh. With Mr. Sugg the evidence concluded; and Mr. Littler thereupon addressed the Committee for the Commercial Company. In replying on the cases of the opponents, Mr. Worsley Taylor spoke with his accustomed vigour, and urged as significant that the fall in illuminating power had only taken place since 1884 when cannel was displaced by the more "ephemeral" petroleum spirit; but he did not explain how it was the change in enrichment had not affected the official testings. A very few minutes' private conference sufficed for the Committee to determine—as they had no doubt individually concluded in their minds long before—that the preamble of the Bill had not been proved so far as it related to the testing of gas.

There was a day's interval between the defeat of Part II. of the County Council measure and the commencement of the consideration of the second item on the heavy programme drawn up for Mr. Oldroyd's Committee. This was the resuscitated Bill of the Gaslight and Coke Company; and it has been brought forward practically in the form in which it was when thrown out by the Lords Committee on June 30 last. It may be remembered that, in the Bill as introduced last year, the Company asked for power to create and issue £3,500,000 of 3 per cent. debenture stock; and that the Commons Committee (to whom the measure was first referred) cut the amount down by a round million. This session the Company limited themselves to the reduced amount; and very wisely, as, if there were not other questions to be taken into consideration on this occasion, a Committee would be hardly likely to quash a favourable decision of another Committee of its own House on a matter of this kind, in which no question of principle is involved, and upon which there is really very little room for controversy. But the Instruction to the Committee to keep in view the recommendations of the Select Committee on the Powers of Charge of the Metropolitan Gas Companies now raises more momentous issues. The proceedings on the Bill covered two days. Mr. Pope opened the case; and the witnesses examined in support were the Secretary and General Manager, Mr. J. W. Field; the Governor, Colonel Makins; the chief officials in the various departments (Mr. G. C. Trewby, Mr. G. F. L. Foulger, and Mr. Thomas Wilton); and, unlike last year, an outside Engineer was brought in in the person of Mr. W. R. Herring, the Chief Gas Engineer of the Edinburgh and Leith Corporations, to uphold the figures of the Company's Engineers as to their requirements. Naturally, to a very large extent, the case advanced by the promoters followed on much the same lines as that of last year; the figures having been merely revised to Dec. 31 last. The necessity for additional capital was again proved; and the proposed method of raising the money by the issue of 3 per cent. debenture stock was shown to be the cheapest plan. The now well-worn reasons for the capital being higher in proportion than that of the other Companies, and for the working expenditure being heavier, were also spread before the Committee. As to the recommendations of Sir John Rankin's Committee, it was not thought an economical proceeding that the Company should be limited in their capital powers to five years; nor was it considered wise that there should be an alteration of the sliding-scale with respect to existing capital. It was confessed, however, that, in regard to the issue of new ordinary share capital, there would not be the same objection to a change in the conditions; although, it was pointed out, the Company would not be able to issue it under the suggested new sliding-scale except at a discount. But the proposals, it was urged, had no bearing upon the present Bill, seeing that power was only sought to raise debenture stock. An explanation was also made to the Committee as to the position of affairs between the promoters and the South Metropolitan Company in regard to the suggested transfer to the latter of the area of the former south of the Thames.

The Bill was opposed by the London County Council, and the Corporations of London and West Ham. The principal desires of these bodies were to ensure that nothing was done in connection with the Bill to prejudice the gas consumers, and to urge the application to the measure of the recommendations of the Select Committee. Mr. Littler, for the City Corporation, went the farthest, and asked the Committee to say the preamble of the Bill was not proved. No witnesses were called by the opposition. For very laudable reasons, the Committee resolved to postpone their decision on the Bill until to-morrow.

The Committee varied the order of their proceedings on Friday by taking up the part of the London County Council Bill relating to the control of the prepayment gas-supply system in the Metropolis. The purposes of the Bill, to put them shortly, are threefold. First, the Council seek to bring under the regulation of the Board of Trade the supply of coin-meters, the fittings, and the charges—that is to say, the Board are, after inquiry, to fix a standard pattern or patterns of meters and fittings, and the charges in payment therefor. Secondly, the Companies are to be compelled to inform users of the meters and fittings of the amount of the charges. This a consumer who can add two and two together can easily find out for himself now. Thirdly, the Companies are to be required to keep and publish separate accounts of their receipts and expenditure in respect of these meters and fittings. Whether intentional or not, the whole proposal is nothing but a gross insult to the Companies, suggesting as it does the possibility, without control, of dishonourable action in their business relations with their poorer customers. The only motive one can find for the County Council taking up the matter at all is the wild desire which seems to possess them to pursue to the extreme their old policy of officiously interfering with public trading concerns whenever there is the slightest excuse or opportunity for doing so. There has been no general complaint on the part of the prepayment consumers with the fittings or the charges; and the fact that the system has grown to such colossal proportions in so remarkably brief a space of time is in itself proof of the consumers' satisfaction, and of fair treatment on the part of the Companies. As traders, the Companies would naturally adopt those methods which would bring them the largest business; and the methods which would do this are not those which are in any way unfair or unjust to the customer. There is no compulsion on consumers to take gas by the prepayment system; and if the British working man, after adopting it, feels there is any robbery or jobbery about it, he will quickly settle his business relations with the Company by ceasing to drop his pennies into the slot. It is true, as pointed out by Mr. Worsley Taylor in opening the case for the Council, that the Select Committee on the Powers of Charge of the Metropolitan Gas Companies last year suggested that the prices for slot meters and fittings should be regulated; but surely that is a question that can be settled by Parliament directly with the Companies, without the intrusion of outside parties. There is no doubt the difference existing at that time in the charges of the Gaslight and Coke Company for the slot meters and fittings on the north and south sides of the Thames greatly influenced the Committee in making this recommendation; but since then the charges have been equalized. It is suggested by the South Metropolitan Company that the extra charge for meters and fittings should be fixed at 9d. per 1000 cubic feet; but the County Council prefer the more elastic method of reference to the Board of Trade.

After the opening by Mr. Worsley Taylor, only two witnesses were called for the promoters—Mr. H. E. Haward, the Controller of the Council, and Mr. W. J. Dibdin. The evidence of the former was directed to a very large extent against the Gaslight and Coke Company; but generally, he considered the prepayment consumers were at present at the mercy of the Companies in regard to their fittings. The remainder of the day's sitting was occupied by the evidence of Mr. J. W. Field, for the Gaslight and Coke Company. He thought that what the Select Committee of last year had in their minds in making their recommendation was not dictation, but regulation by the application to the supply of prepayment meters and fittings of something analagous to the sliding-scale. Generally the contention of the Companies is that the proposals of the Council are unnecessary, impracticable, and unworkable, and would entail great and needless expenditure.

The gas portion of the Walsall Corporation Bill came before a Committee of the House of Lords on Friday. An extension of the gas-works has become absolutely necessary; and for this purpose it is proposed to acquire and use 6 acres of land adjoining the existing works. Owners of shops and houses in the vicinity petitioned against this part of the Bill on the ground that they would be injuriously affected by the extensions; but controverting evidence was laid before their Lordships, who allowed the Bill to proceed.

HOUSE OF COMMONS COMMITTEE.

Monday, May 7.

(*Before Mr.* Oldroyd, *Chairman, Mr.* Emmott, *Mr.* Nicol, *and Mr.* Stanley Leighton.)

THE GASLIGHT AND COKE, COMMERCIAL GAS, AND SOUTH METROPOLITAN GAS COMPANIES BILL.

The Bill promoted by the London County Council to make further provision with regard to testing the illuminating power of the gas supplied in the Metropolis, and to confer power on the Board of Trade to regulate the charge for, and the supply of, prepayment meters and fittings, was further considered to-day.

Mr. Worsley Taylor, Q.C., Mr. Talbot, and Mr. B. Wilkinson, appeared for the County Council. The other Counsel engaged were: Mr. Littler, Q.C., and Mr. H. A. Rigg, for the Corporation of the City of London; Mr. Pope, Q.C., Mr. Claude Baggallay, Q.C., Mr. Danckwerts, Q.C., and Mr. R. J. Neville, for the Gaslight and Coke Company; Mr. Littler, Q.C., Mr. Baggallay, Q.C., and Mr. Snagge, for the Commercial Gas Company; and Mr. Balfour Browne, Q.C., Lord Robert Cecil, Q.C., and Mr. L. W. S. Rostron, for the South Metropolitan Gas Company.

Mr. *C. C. Carpenter*, examined by Lord R. Cecil.

Witness said he was Chief Engineer to the South Metropolitan Gas Company. Since 1884, he had given considerable attention to the carbonizing plant used in the manufacture of gas; and as a result of improvements effected, the production of gas was more regular and uniform than it used to be. But even now gas could not be manufactured of absolutely uniform quality. From 1884 to 1896, the period covered by Mr. Dibdin's tests, the coal used by the South Metropolitan Company was practically the same; and it was now carbonized with much more care than it used to be in 1884. It was during those years that, according to the portable photometer, the gas was alleged to have steadily depreciated in quality. He could only account for this by the portable photometer being an inaccurate instrument. Witness handed in the following table, relating to his Company:—

Year.	Gas Sold Per Ton of Coal.	Illuminating Power.	
		Official Tests.	Portable Photometer.
	Cubic Feet.	Candles.	Candles.
1884	9252	16·6	16·3
1885	9190	16·6	15·7
1886	9487	16·5	15·7
1887	9518	16·4	15·7
1888	9499	16·3	15·6
1889	9386	16·3	15·3
1890	9235	16·3	15·4
1891	9421	16·4	15·4
1892	9420	16·3	15·2
1893	9306	16·4	14·3
1894	9400	16·4	14·6
1895	9341	16·4	15·0
1896	9535	16·5	14·9
1897	9555	16·5	14·6

Lord R. Cecil: What is the conclusion you draw from the table?

Witness: Take 1892 and 1893. In 1893, we sold 9306 cubic feet of gas per ton of coal carbonized. According to the returns of the portable photometer, the illuminating power was only 14·3 candles. In the preceding year, we sold 114 cubic feet per ton more; and the illuminating power was 0·9 candle higher. There was no change made in the process of manufacture. The figures given as to the results of the portable photometer

were from Mr. Dibdin's report. The other two columns were from "Field's Analysis."

In a fortnight's testing, Mr. Dibdin's results show 1 candle less illuminating power than the official tests?—Yes.

There was no possibility of error, so far as the gas was concerned?—No possibility, except in the tests themselves. There can be no question of instability of the enrichment of the gas, or as to the enrichment being partial, because there was no enrichment used. This difference of 1-candle power shows that one or other of the tests was incorrect.

You quote one particular instance, on May 3, when the official return was 15·7 candles at Burridge Road, and when the return at the board-school given by the portable photometer was 13·9 candles, or a difference of nearly 2 candles?—Yes. The tests were made with the same gas, obtained from the same works. Of course, in the month of May the discrepancy would not be so great as it would be in colder weather. The suggestion in the evidence given on behalf of the County Council is that we alter the gas at the official testing-stations.

Is there any truth in that?—Absolutely none.

I believe the orders of the Directors are to supply 16-candle gas?—Yes.

And their instructions are carried out?—They are.

Witness went on to say that three readings were taken at each photometrical test. The first reading mostly gave results lower than the succeeding ones, owing to the gas lying in the pipes not having been exhausted. Mr. Dibdin only took two readings, and, moreover, most of Mr. Dibdin's tests were made in daylight. In the opinion of Professor Vernon Harcourt, the eyes of the operator were not fitted to take tests in daylight. The eyes were at their best when the operator had been for some time in the darkened room.

Mr. Worsley Taylor (in cross-examination): You hold that the discrepancies to which you have spoken are due to the fact that the portable photometer tests are all wrong?—Yes; that is so.

Then in the thousands of tests Mr. Dibdin has made, you think he has been quite wrong?—Yes; because the conditions under which he made his tests were unsuitable for the proper working of the photometer.

Could you arrange suitable conditions for working the portable photometer, if you set your mind to it?—Certainly.

Having the ability to do that, if there were errors in the tests, it would only be through wilfully laying yourself out to produce them?—No; it would be through neglecting to take the proper precautions to provide against them.

Could you, with the portable photometer, take the precautions which are adopted in the case of the photometer at an official testing-station?—It could be done.

Then if it can be done, and is not, what other explanation can there be for failure than that of wilfully shutting your eyes to the conditions that are necessary?—I should suggest that those who made the tests did not realize the importance of the conditions under which they should work.

That is incapacity?—Yes. Mr. Dibdin realized the importance of the conditions in regard to the board-school tests.

Was the portable photometer wrong in 1884, when it gave 16·3 candles, as against 16·6 candles of the official tests?—I should say it was as wrong then as now.

Witness went on to say that the maximum daily manufacture of gas by the South Metropolitan Company was 50 million cubic feet. The three London Gas Companies had, altogether, nineteen manufacturing stations; and the greatest care was taken at each of the stations to see that the gas was turned out of the right quality.

Mr. Worsley Taylor remarked that he had elicited the facts just spoken to by witness to show the magnitude of the operations that were the subject of the inquiry.

In further cross-examination, witness said the amount of cannel used for enrichment by his Company had been a gradually decreasing quantity; carburine and benzol being employed instead. The photometer used was the same instrument throughout.

Re-examined by Mr. Balfour Browne: The conditions of gas testing had been very guarded; and the tests with the portable photometer ought to be as carefully guarded. If so, he would have no objection to the instrument; but this would be tantamount to having new testing-stations. If every foot of gas was taken out of coal, the quantity obtained was more, but the illuminating power less. Mr. Dibdin years ago made an investigation into the standard of light, and in his report to the Metropolitan Board of Works showed that he was very much alive to the precautions which the Companies now said were necessary for proper tests to be made.

By Mr. Nicol: Benzol and carburine were more liable to condensation than enrichment by cannel.

Mr. Nicol: Do you attribute the large discrepancy between your official tests and the tests since 1890 to that effect?

Witness: Yes; that may be so.

If it be so, is this not an indication of the irregularity of the gas arising from the distance from the manufacturing station rather than from errors in the working of the portable photometer?—There is no doubt the use of it is not so permanent; and this we provide for, to some extent, by enriching now more than we used to do with cannel. We enrich up to 17½ candles, and sometimes more.

As a practical man, are you prepared to affirm that the gas you supply now, at a considerable distance from the works, ought to give the same illuminating power as in 1884?—I should not say absolutely, but very nearly.

Mr. *R. O. Paterson*, examined by Mr. Rostron.

Witness said he was Engineer and Manager of the Cheltenham Gas Company; and he had had considerable experience in the photometrical testing of gas. He had recently made experiments as to the effect of variations of temperature on the photometrical examination of gas; and he produced the following table, showing that variations in temperature were accountable for very large changes on the illuminating power of gas. Witness pointed out that, on Sample A, there was a difference between the two experiments of 2·13 candles; and on Sample B, of 1·34 candles. The room was in all cases prepared and perfectly suitable for testing; and the readings were corrected to the standard temperature and pressure. The inference he drew from these experiments was that the variations of temperature affected the reading of the photometer, and that the corrections did not remedy this. Corrections for temperature were made upon the gas only; and no allowance was made for the effect of the moisture in the air upon the flame of the gas—that was a very perceptible depreciation. The more moisture there was in the air, the greater diminution there was in the flame. The alteration in the temperature did not account for all the variation. The tests were made with the bar photometer and candles. Afterwards the 10-candle pentane lamp, now prescribed as the standard, was substituted for the candles on the bar photometer, and similar divergent results were obtained. The experiments showed that the pentane-lamp flame was shortened, as well as the gas-flame, when the room was cooled down; and following the instructions of the Referees, the flow of pentane had therefore to be increased, so as to raise the flame to the prescribed height. The practical effect of increasing the flow of pentane was to restore the standard to its original 10 candles. The quantity of light-giving pentane flowing to the burner had been increased; but the amount of light emitted was still 10 candles, as shown by the height of the flame. What had happened was that the lower temperature and excess of moisture were not permitted to exert their damping effect upon the pentane standard, because, when the damping effect was observed, more pentane was turned on to counteract it. It was different with the gas. With the new form of photometer prescribed, and the 10-candle pentane standard, the gas to be tested was consumed in an argand burner at such a rate as would yield a light of 16 candles. The lower temperature and excess of moisture in the atmosphere damped down the gas, as they did the pentane; and therefore to get the light of 16 candles, more gas had to be turned on. But the consumption of gas had to be corrected to the statutory rate of 5 cubic feet per hour, so that if, to overcome the damping effect of temperature and moisture, it required 5¼ cubic feet per hour to give a light of 16 candles, the illuminating power of gas was reduced to 14·54 candles when corrected to the statutory rate of 5 cubic feet. A further correction was made for volume, if the temperature of the gas and the barometer were higher or lower than the normal. With the gas, volume and intensity were both under observation; but in the case of the pentane standard both were disregarded, and height of flame alone was taken into account, to the exclusion of everything else. This introduced another disturbing factor into photometry, the full effect of which was not yet known. There were no means of correcting the effect upon the pentane standard of a high or low barometer.

Illuminating Power of Stored Samples of Gas Tested under Varying Conditions of Photometer-Room.

Conditions Varied as Stated.	Corrected Illuminating Power.	Temp. of Room. Dry Bulb.	Temp. of Room. Wet Bulb.	Barometrical Pressure.
		Deg. F.	Deg. F.	Inches.
Sample A.				
Stored and tested during evening	16·22	63	57	29·60
Same gas tested next morning, windows open during night.	14·09	53	50	29·60
Sample B.				
Stored and tested during morning	15·24	55	50	29·70
Same gas tested in evening, after warming photometer-room	16·58	67	60	29·70
Sample C.				
Stored and tested in early evening	16·75	67	60	29·25
Same gas tested two hours afterwards, windows opened and room cooled	15·23	58	53	29·25
Same gas tested next morning, windows open during night.	14·42	56	52	29·70
Same gas tested following evening, after warming photometer-room	16·65	66	60	29·50

Cross-examined by Mr. Worsley Taylor: Under proper conditions, the table photometer was all right. It was not alone the temperature that made the difference, but also the vapour in the atmosphere.

Mr. Worsley Taylor: If you have a temperature of 53° and a temperature of 66°, the flame would behave differently—in other words, you have to adjust it differently?

Witness: Yes.

But you always do that. You bring your flame to the same standard height, no matter what the temperature may be?—If you are speaking of the table photometer, of course, you have to regulate the flame of the gas to the 16 candles, irrespective of the quantity of gas required to do it.

The pentane flame is always brought to a standard height?—Yes.

Mr. Leighton: Do you think that observations can be properly taken by daylight?

Witness: Yes; if you have a room in which the ceiling and the walls are darkened, and if the operator has accustomed his eye to the darkness. I myself sit in the photometer-room for five minutes looking under the table, to get my eyes accustomed to the darkness, before making an observation. You must not have merely a screen here and a screen there; you must have an absolutely darkened room.

The Chairman: How long did it take to make your ten readings?

Witness: We make an observation per minute.

I take it that humidity of the atmosphere is equally unprovided for at a test with the portable photometer and with a fixed photometer?—Yes.

Mr. *Henry Woodall*, examined by Lord R. Cecil.

Witness said the evidence of Mr. Isaac Carr had been brought to his knowledge; and he had received instructions from the South Metropolitan Gas Company to go to Widnes to check that gentleman's statements. Mr. Carr had said that the portable photometer in Widnes had showed substantially the same result as the photometer at the testing-station, and that the tests proved that he had kept the gas up to 18½-candle power. On April 26 he (witness) had gone down to Widnes with a portable photometer, and everything necessary for the making of tests with it. He had set up the photometer in a disused office opposite his hotel, and near two railway stations, at a point 950 yards from the gas-works. He had made a series of tests ranging over four days; having been assisted in

the work by the tester of the Liverpool Gas Company, and the tester of the Crystal Palace Gas Company. On April 27, he made four tests; and the average results shown was 14·7 candles. On April 28, the results he obtained averaged 13·10 candles; and on the 29th they averaged 14·84 candles. On May 2, he made six tests, which averaged 14·64 candles. At the first test, the water got into the instrument, and caused some inconvenience and annoyance. After this, however, the conditions improved. The results obtained varied from 15·96 to 12·79 candles. Even the highest of the tests was fully 2 candles below what Mr. Carr said he was able to obtain by his tests.

Cross-examined by Mr. WORSLEY TAYLOR: The legal standard at Widnes was 14 candles; and all the tests were all above that. He tested with candles; and the instrument used was the Dibdin portable photometer. The gas was obtained through a meter.

Mr. WORSLEY TAYLOR: You are satisfied with these tests?

Witness: Yes; so far as they go.

And ready to stand on them?—Yes.

Did you ask Mr. Carr anything about the gas at that time?—No.

Were you aware that, at that very time, Mr. Dibdin was making various experiments; and that Mr. Carr was "knocking his gas about," and producing various qualities for experimental purposes?—No.

Mr. BALFOUR BROWNE then briefly addressed the Committee for the South Metropolitan Gas Company. He said that he had other witnesses, including Mr. Sugg, whose name was very well known in connection with gas-lighting appliances; but he would not trouble the Committee with them. The South Metropolitan Company felt that the only practical Gas Engineer called against them was Mr. Carr, of Widnes, though the promoters had tried to get others. As to the statement that when Mr. Woodall was making his experiments at Widnes, Mr. Carr was "knocking his gas about," this was only a suggestion on the part of learned Counsel.

Mr. WORSLEY TAYLOR: You should not say that. I was told it by Mr. Carr.

Mr. BALFOUR BROWNE said that Mr. Carr had stated that the gas at Widnes was of 18-candle power as recorded by the portable photometer. According to the evidence since given, this was not the case; therefore, the tests showed that the photometer could not be relied upon. Parliament, it was true, had never distinctly said that the consumer was to have 16-candle gas; but it said that the Gas Companies were to have 16-candle gas in their mains, and that the manner in which the Companies were doing their duty was to be tested in a specific manner. He submitted that the County Council, in this case, were seeking to increase the responsibility of the Gas Company. The latter undertook to supply gas in their mains of a certain illuminating power; and the question was, Were the Committee satisfied that the Company had done this? He contended that they had. Parliament was wrong in imposing on the Company the obligation to supply 16-candle gas in their mains. It was a silly thing, and of no use; but the Company had no right to take upon themselves the supply of gas of less than 16 candles. The promoters asked that the standard, as laid down by Act of Parliament, should be altered, and that the Company should be forced to give all consumers 16-candle gas. This meant that the Company must supply gas at so many candles more than at present as would overcome the whole of the difficulty existing between their mains and the premises of the consumers. He protested against penalizing the Gas Company by records taken by the portable photometer, which might be made under varying conditions. If, for instance, they were made in a school-room newly washed, a different result would be obtained to that yielded by a test in a dry room. Then the conditions as to light must be satisfactory; and altogether he submitted that the requirements were such as could only be complied with at an establishment arranged and fitted like the existing official testing-stations. He urged the Committee not to leave it to the Gas Referees to say what kind of place the test should be made in, because they had already decided the point. They had selected the existing testing-stations, and had prescribed, after years of experience, the conditions under which the tests should be carried out. He had absolutely nothing to say about the portable photometer; but as regarded the obligation which it was sought to impose on the Gas Company to supply 16-candle gas at every place in their district, he protested against it. It meant that the Company would have to supply gas of 1 or 2 candles higher illuminating power; and who was to pay for this? Not the County Council, and not the Gas Company. Even if the consumers obtained the gas of higher illuminating power, what would they do with it? Quite 50 per cent. of the gas burnt in London—certainly during eight months of the year—was used for heating purposes; and in respect of this 50 per cent., the higher illuminating power was useless to the consumers, though they would have to pay for it. What the consumers really wanted was cheap gas; and the effect of the Bill would be to make them pay something like 2d. per 1000 cubic feet more. Even Professor Vernon Harcourt had said that what was wanted by the London consumers was cheap gas of a lower illuminating power. There could not be the slightest doubt that at the testing-stations the various Companies had supplied the gas required. He did not say they had done it all over the district. They were not bound to do that; but if they were compelled to do so, the additional cost to the consumers would be something like £126,000 a year. They would have to pay this amount for a thing which they really did not want. He asked the Committee to say that there was no case made out for the portable photometer. He hoped when the Committee heard the Bill of the South Metropolitan Company, they would come to the conclusion that high illuminating power was a mistake; that petroleum spirit enrichment of gas was a mistake; and that water-gas enrichment was not only a mistake, but was dangerous. There ought to be no enrichment. The Gas Company ought to be able to supply the gas simply as it came from the coal as it was brought from Durham. When he came to the Bill of the South Metropolitan Company, he should ask for 14-candle gas instead of 16-candle; but he did not propose to ask for that for nothing. If the supply of gas of a lower illuminating power was assented to, the Company would reduce the price to the public. He urged the Committee not to put the proposed new obligation on the Company.

Mr. LITTLER, for the Corporation of London, said that his clients were not, like the County Council, so absolutely convinced of the advantages of the proposal contained in the Bill. He did not himself propose to say anything for or against it. He would leave it to the Committee to form their judgment on the matter, from the information they had got from the County Council and from the different Gas Companies. But what he did say was that, if the Committee should come to the conclusion that the jurisdiction asked for in the Bill was one that should be given, the Corporation did not think they would be doing justice for their constituents if they did not ask that they should have the same rights as the citizens within the County Council area. They wanted it made clear that in the City the matter should be in their jurisdiction—that the gas testing should be done by them, and not by somebody else for them. Clause 3 commenced as follows: "Any two examiners may, at any time make, at any place within the district supplied by any of the Companies, tests for ascertaining whether the illuminating power of the gas supplied by such Company at such place is that required by law." He would propose that these words should be preceded by the words: "Within the respective jurisdictions of the County Council or the Corporation any duly appointed."

The CHAIRMAN thought the learned Counsel might well leave the matter in the hands of the Committee, who would see that the position of the Corporation was duly protected.

Mr. WILKINSON did not think it right that the Committee should have to consider the form of the words.

Mr. WORSLEY TAYLOR said the County Council would accept the principle of the amendment, but would ask for time to consider the exact wording of the proposal.

Mr. LITTLER then proceeded to place the case for the Commercial Gas Company before the Committee.

Mr. *H. E. Jones*, examined by Mr. LITTLER.

Witness said he had been Chief Engineer to the Commercial Gas Company for the past 31 years. He was also Consulting Engineer to a number of important gas companies. Up to fifteen years ago, he constantly used photometers, and occasionally still took tests. In 1889, along with Professor Vernon Harcourt, he acted as Joint Arbitrator for settling the question of the photometers to be used and of the testing-rooms in Dublin; and, by agreement with the Corporation and the Company, they had to certify the suitability and propriety of the photometer and the conditions of the testing-rooms for that purpose. Thus the points in question were not fresh to him. Strangely enough, in that case there were vague imputations of manipulation—as in the present instance—which fell through during the investigation. At the outset, he desired to repudiate emphatically the sinister inferences and suggestions underlying the case which had been put forward by the promoters of the Bill. The supply of gas to the testing stations was common to the whole districts, and the gas was made and delivered uniformly throughout the 24 hours. No enrichment had ever been employed, other than that at the purifying plant at the gas works, so that it would be uniform and general. The Company never knew when the tests were going to be made, and were not represented at, nor interfered with, the testing. There had been rare interviews between the Company's Chemist and the Examiner, chiefly as to verifying some point of purity tests. With regard to the places of testing, those fixed by the Referees in the Commercial Gas Company's district were such as furnished very poor conditions for the Company. They were both very near the extreme margins of the Company's area; and they were neither of them fixed in places where a supply could be taken from any large arterial main.

Mr. LITTLER: Is it the fact that when first put into action the photometers had to be changed as they admitted reflected light?

Witness: Yes. One of the Examiners said they were unsatisfactory; and they were submitted to a practical photometer maker.

With regard to the condition of the photometers at the testing-stations, the new portable photometer is a copy of an entirely novel instrument, is it not?—Yes; and the notification to fit up such instruments by the Referees is not yet two years old. The Company have not yet had much experience of them. With regard to the condition of the room, the Referees had some trouble with the ventilation at the Parnell Road testing station, and had the heating apparatus altered so as to improve the action of the photometer. The inference and aim of the evidence for the Bill suggest that the Referees have not sufficiently studied the question. The matter is one requiring careful study and investigation, which the Committee will see when I tell them that at the end of 3 hours' testing only 2½ cubic feet of gas are used out of a daily supply of 14 million cubic feet.

Each of the works of the Commercial Gas Company has only one large delivery main, which branches off outside the works?—Yes. Only by stopping the supply entirely (which is not practicable) from one works, could gas from another works reach the respective allotted testing-station. Each is naturally supplied by the works nearest to it.

In your view, the testing-stations would be still better placed if they were upon the main outlet of the Company's works?—Yes; but inasmuch as the Referees have always been at liberty to fix the testing-stations where they thought fit, they could have satisfied themselves that they tested the gas in the most reasonable and fair manner for the consumer. The Company would not consider a reasonable and fair manner the testing of stale damaged gas, or an attenuated stream of gas through too large and remote fittings—especially in very cold weather—or the testing of any gas in a room where the temperature was much below 60°, or such comfortable temperature as the consumers would employ in their own living-rooms.

In further examination, witness said, if a less accurate or less efficient mode than the present were adopted, it would upset the whole conditions under which the Companies worked. The portable photometer with the pentane standard would not be so simple, nor work so well, under a rough and hasty installation as the old candle photometers. This might explain the greater difference in later tests. At the time the Company accepted the Act of 1875, they only knew of one method of testing—namely, by enclosed photometers, and in fixed testing-places; and this was the foundation of the parliamentary settlement. If testing was allowed, in improper places and in too hasty a manner, of gas which might be damaged, to avoid penalties it would be necessary to provide an excess of illuminating power beyond the ½-candle which even the present limit necessitated; and as all additional illuminating power over that prescribed by ordinary Durham coal was less

permanent, the increased cost would be out of all proportion to its relative value. Referring to the cases in which it was said the tests showed gas of 12 and 13 candle power, his records proved that he could not, unless he had deliberately poisoned his own gas, have made such gas. His figures gave an average of 17-candle power; so that the tests applied to the Commercial Company were preposterous. The legislation proposed would handicap the Company in competing, by causing an increase of price. The shareholder would pay only about one-seventh of the burden thrown on the Companies. If it was important to ascertain the deterioration in the quality of gas consequent on its passing through small dead mains or consumers' fittings, it was of equal interest to the whole of Great Britain; because any legislation would ultimately concern, by precedent, the entire country. Before legislation of this kind, there should be an inquiry as to the whole conditions of gas manufacture, at which gas companies as well as local authorities should be represented. Much of the trouble the consumers had had was due to stoppage in the pipes caused by crystals of naphthalene, which was a chief illuminant. One of the greatest advantages of water gas was that it did not deposit naphthalene.

Witness was not cross-examined.

By Mr. LEIGHTON: The best remedy for the present state of affairs would be a lowering of the statutory standard.

Dr. *Odling*, examined by Mr. LITTLER.

Witness said he agreed in the main with Professor Dewar's evidence. The method proposed in the Bill was substantially impracticable, unreliable, and unjust to the Companies. Therefore it was unreasonable in the interest both of the consumers and the Companies. The Bill, if passed, would force the Companies to increase the candle power of their gas very considerably; and this meant a higher price to the consumers, without corresponding advantage.

Mr. *W. Sugg*, examined by Mr. LITTLER.

Witness said since 1858 he had been engaged in the manufacture of photometers, and in making photometrical experiments with all kinds of burners. He was the inventor of the London argand burner—the standard mentioned in Acts of Parliament. Under the direction of the Referees, he had fitted up the 23 testing-stations in London, and made the photometrical apparatus for them. Witness gave evidence as to the necessity of the tests being conducted under proper conditions, and said the present testing-places were the right and only places in every respect for the tests to be made. They had been carefully selected so as to give a fair test of the gas supplied. It would not be fair to make a test at any house—indeed, testing-stations had had to be removed, because for various reasons they did not give fair results. The Bill would force the Companies to increase the quality of the gas they sent out, which was unreasonable, and would add to the cost to the consumer. The Bill was absolutely impracticable.

This concluded the evidence.

Mr. LITTLER then addressed the Committee for the Commercial Gas Company. He said the Bill was promoted by people who, with the sole exception of appointing the Gas Examiners, had no interest in gas. So far from that, it was extremely likely that some of the large ratepayers would go before the Auditor to see whether they had any right or power to introduce the present Bill at all. The Referees made no complaint; and although the Gas Examiners did, he had to remark that they were appointed by the County Council, which was a serious matter for the Companies, because the Council having a strong view on this matter, they would only appoint such Examiners as would take the same view. The whole matter was one of burners, for with the best type of burners plenty of light could be obtained, whether the gas was ½ candle above or below the standard. Even now the London Companies were penalized to the extent of 1 candle; because, whereas in the country generally the Board of Trade standard was 15 candles, in the Metropolis it was 16. The County Council sought the right of going wherever they pleased to make an investigation, under whatever conditions they thought fit; and then if they found a result, according to their judgment, contrary to the Act, the Companies were to be penalized. There was to be an examination at which the Companies were not to be present, and of which they were not to have notice, because the County Council insinuated that if they were given notice they would manipulate the gas—which was one of the most ludicrous things which could be suggested. The result was to be, first, a penalty, and then (which was far worse than all penalties), a bad character among their customers. This was most unreasonable. Was this the time to introduce a new and serious element of cost and anxiety into the affairs of gas companies, when they were feeling—though not to the full, because it had not yet been perfectly developed—the competition of electricity; and when, as they learnt from the papers that morning, there was an increase of 5s. per ton in the price of coals? There was absolutely no case of public advantage, because it was only when improper burners were used that this high standard was wanted at all. The City were not consulted by the promoters before the Bill was introduced, because they knew very well the City would have told them not to interfere with what was going on very well. There was no one asking for this system of testing over the enormous area of supply. Were the Committee satisfied that it would be just? Were they satisfied that the County Council ought to be allowed to set up this system of testing, with no one to supervise them, and with no one to check them? The present position was a tolerably tyrannous one; the Companies being under the thumb of the Gas Referees, and there being no appeal against them. It was now proposed that they should be under the tyranny of the Gas Examiners. They were to be tried by the County Council, who were to be the prosecuting counsel and judges. If the Companies were right in their view as to the result of this Bill, was it not remarkable that the measure was brought forward at a time when the County Council were talking about purchasing the gas undertakings? If the Council could reduce the profit of the Companies, down would go the price to be paid for the concerns. This was a reasonable explanation, not of why the Council should expect to pass their Bill, but of their reason for trying it on. In conclusion, he submitted that no public case had been made out; no complaint had been established. Was the gas under the present legal test shown to be deficient? If it was, it was the duty of the County Council to have compelled the Companies, under the Act, to improve the supply. There had been no case made out before the proper authority. A number of vague charges were made; and he would ask the Committee to reject a Bill which would simply increase the responsibility of the Gas Companies and increase their expenses and the price of gas, without a corresponding advantage to the public.

Mr. WORSLEY TAYLOR, replying on the cases of the three Gas Companies, declared that the question before them was a practical one; and he could not deal with it like his learned friends in a general way. He had to prove his Bill, and was, therefore, compelled to go into detail. His clients were there asking Parliament to alter existing legislation, which was important in itself, and had been carefully settled; and he accepted on behalf of the County Council the full responsibility which attached to anyone seeking to alter existing legislation. The object of the legislation had been to get 16-candle gas.

Mr. NICOL: Where?

Mr. WORSLEY TAYLOR: At the fixed places, under conditions laid down by the Referees.

Mr. NICOL: Testing in a private room would be fair?

Mr. WORSLEY TAYLOR: No; it would not be according to existing conditions. Continuing, he said the County Council contended that it should be 16-candle gas taken from the main in front of the house of the consumer. He contended that the existing legislation had not effected the object with which it was passed—viz., of securing 16-candle gas to the consumers. According to Mr. Dibdin, there had been a steady decrease in the quality of the gas supplied in London from 1889 to 1896; and he (Mr. Worsley Taylor) failed to see how Mr. Dibdin's evidence had been shaken. The only way they could get over it, was by saying that Mr. Dibdin's portable photometer was not a reliable instrument. The learned Counsel then referred in detail to the evidence of Dr. Clowes and Dr. Hehner, which proved absolutely, in his opinion, that the present system of testing had failed. But beyond the witnesses in question, there was the evidence of a witness called by the Committee, Professor Vernon Harcourt, who was beyond suspicion as to ability or bias, and who did not think the gas was tested so as to ensure that 16-candle gas was supplied in the mains all over the London districts; and he had added that the present system of testing was unsatisfactory. It was clear, therefore, that the existing method had failed to effect the object originally intended. There was a solution of the problem which was free from any offensive suggestion. The Companies each had varying works, and varying qualities of coal and methods of enrichment. Here were causes of error without end; and it was absolutely necessary that extreme vigilance should be exercised in testing the gas. It was shown that, in the case of the South Metropolitan Gas Company, according to the portable photometer, the illuminating power of the gas had fallen from 16·3 candles to 15·7, 15·6, 15·3, 15·2, and 14·3 candles; and that it now stood at 14·6 candles. It was significant that this fall in illuminating power had taken place since 1884, when cannel coal for enrichment had been changed for the more ephemeral petroleum spirit. If he had satisfied the Committee that the existing system had failed, how was it to be altered? It was suggested by an extension of the testing-stations; but Professor Vernon Harcourt's evidence negatived this. He said he did not think it desirable there should be any multiplication of stations on the present lines, but that some testings from place to place would give useful information which the present system did not afford. Therefore the answer of the Official Referee disposed absolutely, and for ever, of the question of multiplication of testing-places. The only thing which would give the desired result was the present Bill. All conditions as to testing, except three, were left in the hands of the Gas Referees; and by the Bill, no alteration was made as to two—viz, the burning of the gas at the rate of 5 cubic feet per hour, and the employment of the argand burner. The only alteration was in the third point—as to fixed stations. It was not suggested that the testers should go to any place, but that the Referees should prescribe the class of place; and this it was thought would be covered by the substitution of the following for what was contained in the Bill:

> The Gas Referees shall also make, from time to time, regulations prescribing the conditions to which any place at which tests under this Act may be made shall conform; and a penalty shall not be recoverable in respect of deficiency of illuminating power ascertained by a test made at any place not conforming to the conditions so prescribed.

No one disputed that the Gas Referees were to be trusted. They could be left, therefore, to prescribe how the tests should be made. If the Bill was a just Bill, it should be passed without regard to penalties; and, moreover, if there were penalties, the case would have to be proved up to the hilt, so that there was a safeguard in this for the Companies. The result of the Bill would not be the infliction of penalties, but a more rigorous regard by the Companies to the production of the gas, with the result that the consumers would get that to which they were entitled—viz., 16-candle gas. The Bill was just to the Companies, and just to the public; and he therefore asked the Committee to pass it.

The room was then cleared. On the re-admission of the public after a few minutes' interval,

The CHAIRMAN said: The Committee have considered the preamble of this Bill so far as it relates to Part II., called Testing; and they find the preamble is not proved.

The Committee then adjourned until Wednesday; the remainder of the County Council Bill being postponed till a later period.

Friday, May 11.

To-day the Committee proceeded to consider Part III. of the Bill.

Mr. NEVILLE said the Gaslight and Coke Company had no petition against the South Metropolitan Bill; and as that measure was to be considered with the second part of the Bill of the London County Council, against which they had petitioned, he wished to know what his position would be.

Mr. WORSLEY TAYLOR pointed out what Mr. Neville's position would be according to the etiquette of the Bar.

Lord R. CECIL said that the learned gentleman wished to define before the Committee the attitude the Company took, and that ample opportunity would be afforded to him for doing so.

The CHAIRMAN remarked that the Gaslight and Coke Company would scarcely have *locus standi* against the South Metropolitan Bill.

Mr. WORSLEY TAYLOR then addressed the Committee in explanation of the second part of the Bill of the London County Council. He said that he should rely for the strength and his case very largely on the report of Sir J. Rankin's Committee of last session. The preamble of the present Bill contained the following:—

And whereas the price which the said Companies may charge for gas is regulated under the provisions of divers Acts of Parliament: And whereas under, and by virtue of, section 19 of "The Metropolis Gas Act, 1860," the said Companies are entitled (amongst other things) to enter into any contract with any owner or occupier for supplying him with pipes, burners, meters, lamps, and other apparatus, in such manner, and on such terms and conditions, as the parties agree: And whereas since the passing of the last-mentioned Act a system has been widely adopted by the said Companies by which prepayment meters and other fittings are supplied by the Companies to consumers, and the consumers so supplied pay from time to time to the Companies sums which include both the price of gas and a charge in respect of the supply of such meters and other fittings, but the mode in which such sums are made up is not stated to the consumers: And whereas the statutory provisions regulating the price of gas are thus in danger of being defeated: And whereas it is expedient that the supply of such meters and fittings and the charges therefor should be regulated by the Board of Trade, and the amount of such charges stated to the persons who pay them, and that the said Companies should keep and publish separate accounts of their receipts and expenditure in respect of such meters and fittings.

This showed the object of the Bill. There had been certain legislation fixing the price of gas to be charged to the consumers by all three Companies. Each of them had power to enter into contracts for the purposes then known to Parliament, and contemplated by Parliament and by the probable consumers and the Companies. But since this legislation an entirely new business had grown up, owing to force of circumstances, to the advantage of the Companies and the public. This new business not having been contemplated when the legislation was passed, had not been dealt with by Parliament; and it was to the interest of the consumers that it should be dealt with in a manner just to them and to the Companies. That it was a new and very extensive business no one would dispute. Last night he had looked over the evidence given before Sir J. Rankin's Committee, though he had not had time to examine it very exhaustively. He had observed one or two facts; and an expression of Mr. Livesey's had caught his eye—it being a very suggestive one. Mr. Livesey had stated how the prepayment system was started by some one in Liverpool; and, to use his graphic expression, "the idea went like wild fire." The business had only been eight or nine years in existence—ten at the outside. In 1898, the Gaslight and Coke Company had something like 100,000 of the slot-meters in use; and the South Metropolitan had about 80,000. He had been unable to find the number of the Commercial Gas Company's meters; but seeing that at that time the two Companies he had mentioned had 180,000, he should be well within the mark probably if he said that there were now in London 250,000 of these meters. If this were so, it was desirable, in the interest of the consumers, that the charge made for the fittings should be known, and should be regulated in a proper manner. It was an important question now; and seeing that there had been a wonderful development of the system in a few years, and knowing as they did that the plea raised by company after company all over England for a large increase of capital was the expenditure necessary in consequence of the probable rapid future extension of the slot-meter system, they could not but admit that at the present time the matter was one claiming the attention of Parliament. This was all he need say as to the importance of the question the Committee were asked to decide. At the present time, it was clear that there was regulation of the charge for gas; but there was no regulation with regard to the price at which the fittings should be supplied. They were all furnished by the Companies. It was profitable to supply them. The Companies sold their gas, as they would not otherwise do; and, of course, they got their profit on the fittings. The case they made out themselves was that, by the use of the prepayment meter, they encouraged the consumption of gas, and in this way brought in a class of people as customers who could not afford to take gas in the ordinary way. Therefore, the Companies were only too glad to provide these fittings. They had found it to be to their interest to do so. The price of gas was fixed; but the Companies made an all-round charge of 1d. per 25 cubic feet, or whatever it might be—the charge being a certain fixed proportion to the price of gas. Whatever was over and above that, was clearly profit, and went to pay them for the original cost and annual charge in respect of fittings, and everything in connection with the working of fittings—checking them, keeping them in order, the cost of collection, and so on. Therefore, as there were only regulations fixed as to the price of gas, it followed that the Companies were at liberty to charge any sum that the consumers might agree to pay for the cost of fittings, including working expenses. Manifestly it was absolutely impossible for the consumers—especially those of the class for whose benefit the slot-meter system had been introduced—to go into anything like satisfactory detail with the Companies as to how much they had individually to pay for the fittings over and above the price of the gas. This, clearly, must be left to the Company. It was of great advantage to the public to have the slot system; and the Companies, on their part, had admitted that it was to their interest to supply the meters. It thus appeared to the County Council to be only fair and just that there should be some means of regulating the charge. In the case of the three London Gas Companies, different charges were made. Why? The gas supplied by them was charged for at the same rate. Why should not the same charge be made for the fittings? And, further than this, they had the extraordinary fact that, in the case of one Company—the Gaslight and Coke Company—a different charge was made on the north side of the Thames for the fittings to that levied on the south side. There was also a difference in the charge for gas. If a deduction were made so as to eliminate the charge for gas, and get what was represented by the charge for fittings on the north side, they would see that a charge of 9½d——

Mr. NEVILLE: The charges are the same now.

Mr. WORSLEY TAYLOR said he was much obliged to his learned friend for the correction. This was an illustration of what it was open for the Companies to do. Last year the charge was 9½d. on the north, while on the south side it was 1s. 2½d. for practically the same fittings. The charges were the same now; but they might be altered to-morrow. This was the sort of thing which ought to be prevented. The Committee of last year said: "The Committee desire to draw attention to the differential charge made by the Gaslight Company for automatic meters in the northern area, as compared with the southern area. It appears, from evidence given by Mr. Field, that, although compelled by law to charge the same price for gas to their slot-meter consumers in the two areas as is charged to other private consumers—namely, at the present time, 3s. in the north and 2s. 2d. in the south—the Gaslight Company make a different charge to slot-meter consumers in these two areas for the use of their fittings. That is to say, they charge the slot or automatic gas-meter consumer in the north 3s. 9½d. per 1000 cubic feet, and in the south 3s. 4½d.; and as gas must be sold at 3s. in the north and at 2s. 2d. in the south, it is obvious that the charge for fittings is 9½d. in the north and 1s. 2½d. in the south. As the fittings appear to be the same in both areas, your Committee consider that the higher price charged for them in the south is altogether unjustifiable; and they are of opinion that a clear statement of the rates charged for gas, meters, &c., should be furnished to each consumer." On this, their recommendation was: "That the charge made by the Gaslight and Coke Company for the rents of automatic meters and stoves should be the same to consumers north and south of the Thames for fittings of the same quality and capacity; and that the prices charged by all the Companies for these slot-meters and fittings require regulation, having regard to the fact that the business is a new one and has extended with extraordinary rapidity throughout the Metropolis." He asked the Committee to act on this recommendation. It was one which commended itself, especially as the South Metropolitan Company had introduced in their Bill power to regulate their charges. The real question was, What was the best method of carrying out the recommendation? The price ought to be such as would be just to the consumer and fair to the Company, having regard to their charges and their title to a fair profit on the capital employed. The County Council said: "Leave the whole matter to the Board of Trade;" the South Metropolitan Company, who alone proposed to deal with the question, said: "Stereotype now a fixed price"—the price suggested being 9d. per 1000 cubic feet. All the consumer ought to pay was a fair return to the Company. The more elastic method of reference to the Board of Trade must be the fairer. The Bill provided that: "As soon as may be after the passing of this Act, the Board of Trade shall, after holding an inquiry, approve a standard pattern or standard patterns of prepayment meters and fittings for use in connection therewith." At the inquiry, all the Companies would be represented; and the Board of Trade would decide between the rival sets of meters. Then the Board of Trade "shall fix for the use of such meters and fittings by the consumers such charges per 1000 cubic feet of gas supplied by means thereof as they may think reasonable, having regard to the fair and proper cost of supplying such meters and fittings." This recognized payment in the way familiar to the Companies—namely, the price per 1000 cubic feet—so that they would still be able to charge a penny per so many feet, as they did now. Then the Board of Trade were to inform the Companies and authorities of the standards and charges, and the Companies to give information to the consumers. The next clause said: "Any person who is entitled in respect of the ownership or occupation of any premises to be supplied with gas by any of the Companies, may, by notice in writing specifying such premises, require such Company to supply thereon standard fittings; and they shall within a reasonable time supply the same accordingly, and shall keep in repair and renew the same when necessary." This was putting on the Companies the obligation to keep a supply of standard fittings, and to furnish them when required; but it was no new hardship, because it had been proved repeatedly that this was one of the most profitable parts of the business. The clause proceeded: "If such person requires such Company to supply standard fittings on any premises on which there are in working order and repair similar fittings already supplied by such Company, the Company shall not be bound to supply standard fittings on such premises until such person shall have paid to them the reasonable expenses of replacing, either by substitution or alteration as the case may be, the fittings already on the premises by standard fittings. Any question as to the amount of such payment shall be decided by a Court of Summary Jurisdiction." This was a matter of precaution, and was clearly right. Clause 12 provided that each of the Companies should keep, in a form to be approved by the Board of Trade, a separate account showing all expenditure and receipts in respect of prepayment meters and fittings, and should furnish to the Council and the Corporation copies of such account with their annual statement of accounts. Clearly there was no difficulty in doing this; it being a new business, separate and distinct from the rest. Clause 13 proposed that if at any time after the expiration of five years from the date of an inquiry under this Act, any of the Companies or the Council, or the City Corporation, requested the Board of Trade to revise the patterns or the charges, such an inquiry should be held, and an alteration might be made. The petition of the South Metropolitan Company dealt with the County Council Bill very shortly: "Your petitioners respectfully submit that the provisions of the Bill [the one promoted by themselves] are quite sufficient, and thoroughly practicable, for the regulation of the supply of gas by means of slot-meters; while the proposals in the Bill of the London County Council are, your petitioners respectfully submit, and are prepared to prove, unnecessary and unworkable." They did not dispute that the recommendation of the Committee of last year should be given effect to; it was really a matter of clauses. Let the Committee contrast this with the position of the Gaslight and Coke Company. They said: "Your petitioners wholly controvert, and strongly challenge and object to, each and every allegation and statement contained in the preamble, so far as the same relates to your petitioners' prepayment meters and fittings; and they strenuously deny that the existing statutory provisions regulating the price of gas are in any danger whatever of being defeated; and they strongly controvert and challenge the necessity or expediency of regulating the charges to be made for the supply of prepayment meters and fittings; and they strongly object to each and every clause of Part III. of the Bill on the ground that the provisions thereof are offensive, unfair, and unjust to your petitioners"—this was in face of the recommendations of the Committee of last year—"and in violation of the previous legislation upon the faith of which a large portion of your petitioners' capital has been subscribed, and are impracticable and unworkable and wholly

unnecessary in the interests of the consumer; and they respectfully submit that none of the provisions of Part III. of the Bill are justified by the acts or conduct of your petitioners in relation to the supply of prepayment meters and fittings, and that such provisions are and can be only justifiable on the preconceived assumption that your petitioners have acted, or intend to act, fraudulently, or that they have abused the powers entrusted to them by Parliament in regard to the same." The Bill was based absolutely on the recommendations of the Committee of last year; and it was to be regretted that people should put allegations of that kind on the face of a petition. Then they drew attention to the fact that the initial cost of prepayment meters and fittings and installation was exceedingly heavy in proportion to the consumption, so that they must entail a proportionately heavy capital outlay, while the cost of keeping them in repair was very considerable; and owing to the shifting nature of the population using gas in this way, the fittings were extremely liable to remain idle. The allegation, therefore, that their capital expenditure was unduly high was unjust. All these things might be true; but they were matters which the Board of Trade would consider. The Company further pointed out that the circumstances under which the installations of prepayment meters and fittings were made necessarily varied in almost every case. Again, this was a matter for the Board of Trade. Then the Company objected to the inquiries proposed by the Bill as wholly unnecessary, and as causing great and needless expenditure to them; but the County Council, and presumably the Companies also, would not ask for a revision unless there was good reason. The Company also took exception to clause 12; holding that the separate accounts thereby directed to be kept would be misleading and useless for all practical purposes, besides which it would be misleading and useless to treat the business of supplying gas by prepayment meters and fittings as separate. Then they said it was impossible and impracticable. Surely this was a matter of evidence; and he should be surprised if the Company attempted to show that the idea was impracticable. There could be no question that the proposal was right; for without accounts of this kind, how were the Board of Trade to go into the matter for the purpose of revision? Further, the Company challenged the right of the County Council to promote the Bill. This meant, if anything, that nobody was to deal with the matter. The points, he added, in conclusion, in the petition of the Commercial Company were practically covered by the other petitions.

Mr. *H. E. Haward*, examined by Mr. WILKINSON.

Witness said he was Controller of the London County Council. Before the Select Committee of last year, he drew attention to the fact that the charges made by the Companies for gas supplied through automatic meters were not the subject of regulation. In 1898, the automatic meters in the districts of the Companies were as follows: Gaslight and Coke Company, 99,607 meters, and the gas consumed through them 1,634,750,000 cubic feet; South Metropolitan Company, 80,115 meters, and the gas consumed through them 1,281,840,000 cubic feet; Commercial Company, 9551 meters, and the gas consumed through them 114,612,000 cubic feet. Altogether, there were upwards of 190,000 consumers in the districts of the three Companies taking gas in this way; the amount so supplied being 3000 million cubic feet; and the income derived £523,000. Since then, the number of meters had increased rapidly. In the South Metropolitan area, the price was lower than that of the Gaslight and Coke Company; and the former Company had a much larger proportion of this business than the latter. Fittings of this sort were chiefly supplied to the poorer classes; and consequently they would not be in a position perhaps to discover how much they were paying for fittings, and how much for gas. Up till March last, the Gaslight and Coke Company were charging to ordinary consumers north of the Thames 2s. 11d. per 1000 cubic feet, and to the automatic consumer 3s. 8·45d.; so that the actual charge for automatic fittings was 9·45d. The charge to ordinary consumers south of the Thames was 2s. 1d., and to automatic consumers 3s. 4d.; so that the charge for fittings was 1s. 3d. In the South Metropolitan area, the charge to ordinary consumers was 2s. 1d., and to automatic consumers 2s. 10d.; so that the charge for fittings was 9d. In the Commercial Company's area, the charge to ordinary consumers was 2s. 6d., and to the automatic consumers 3s. 4d.; so that the extra charge for fittings was 10d. Since March last, the Gaslight and Coke Company had altered their price for gas south of the Thames to 2s. 1d. per 1000 cubic feet; so that the charge for fittings was now only 9d., instead of 1s. 3d. It looked very much as if they had overcharged for fittings before last March; and the overcharge appeared to have been 6d. There were 12,000 consumers south of the Thames; and they consumed on an average 16,000 cubic feet of gas per annum. On this basis the extra charge of 6d. worked out to about £5000; so that the Company were really drawing from the poor people about £5000 more than they stated to have done. Witness went on to quote in detail the evidence given by the various Companies last year regarding the prices charged for automatic fittings. Mr. Field, he said, did not account for the difference of charge for fittings in the case of the Gaslight and Coke Company north and south of the river; and this was a point which struck the Committee very much. It was admitted that the fittings of this Company north and south of the Thames were the same, though the price was different. The consumer was now absolutely at the mercy of the Companies as regarded fittings. The Gaslight and Coke Company's price in 1898 to ordinary consumers was 2s. 10d. per 1000 cubic feet, and to automatic consumers 3s. 4d.; so that 2s. 10d. was for the gas and 6d. for the fittings. When they raised the price to their ordinary consumers by 2d., prepayment consumers received 22 cubic feet instead of 25 for a penny. The result was that the price of gas to automatic consumers north of the Thames was increased 5½d. per 1000 cubic feet, whereas the price to ordinary consumers was only increased by 2d. All this showed that the whole system of automatic supply required regulation. Witness, with other officers of the County Council, saw Sir Courtenay Boyle at the Board of Trade; and the suggestion that these points should be embodied in the Bill with regard to photometer tests came from Sir Courtenay Boyle himself. He was impressed with the necessity for regulation.

Cross-examined by Mr. DANCKWERTS: You propose to put one particular competitor of the trade under directions to supply a specific kind of fitting only, at a special price only, and compulsorily. That is so, is it not?

Witness: Yes. He agreed that the charges for fittings were not regulated in provincial towns; but they should be. He denied that the present proposal was practically to dictate how the Companies should carry on their business.

Counsel handed in a form, which showed that the charge for automatic fittings had become equalized on both sides of the Thames.

Asked whether this did not show a desire on the part of the Company to comply with the recommendations of the Committee, witness said it was very tardy compliance. In further cross-examination, he agreed that the Company might supply a man with automatic fittings; and, unless the man consumed gas, they would receive nothing. Or he might move away next day; and if his successor did not choose to adopt the automatic method of supply, there would be a great loss to the Company. But these things were provided for in the charge.

Cross-examined by Mr. BAGGALLAY: The Commercial Company, under their Act of 1875, were expressly authorized to make meters. He had heard of no complaint from this Company with respect to the supply of fittings. He should not have thought this was a class of fittings which was constantly changing, though he was prepared to learn that there was variety.

Mr. BAGGALLAY; Do you not think it would be a great mistake to standardize these fittings?

Witness: I do not think so. I think the Board of Trade could exercise proper discretion in the matter. They would not standardize every single pipe that is used.

Can you give me any idea as to the nature of the complaint, if any, that has been made as to the fittings which have been supplied?—We have not had any complaint as to the nature of the fittings; but it appeared to the County Council that the fixing of a price involved the settling of a fitting, because you fix the price for the supply of a certain article. The complaints would necessarily go to the Company, not to the County Council.

Does it not strike you that it would be a serious thing, unless there was good reason for it, that you should standardize the fittings?—No.

That the very standardizing would tend to hamper the development of this business, the past development of which has shown that it is a very useful business for the purposes of the consumers?—I do not think so.

Cross-examined by Mr. ROSTRON: He had no reason to think that consumers through these meters in the South Metropolitan district were not satisfied. The Council supposed the South Metropolitan Company understood their business; and they did not wish to interfere with them more than they could help.

Mr. ROSTRON: All these provisions in the Bill as to the Board of Trade stereotyping certain classes of fittings, sending round notices, and making restrictions on agreements between Companies and consumers, are simply put in to enable a price to be arrived at?

Witness: The Council thought it would be best to leave this to be settled by the Board of Trade, rather than stereotype a price in the Bill. It is a question, not only of a proper price now, but in future.

Therefore, if we can arrive at this price without all these provisions, you would have no objection to our Bill?—If you can arrive at a fair price applying to all the Companies, not only now, but in the future, that would be satisfactory.

Can you tell me what protection your Bill provides for the consumers who do not adopt standard fittings?—They can still enter into an agreement with the Company, under clause 10.

The Bill contains no regulation as to the price to be charged such a consumer?—No.

By the CHAIRMAN: If there were new inventions, or fresh mechanical appliances, the Board of Trade would have power to standardize them.

Mr. *W. J. Dibdin*, examined by Mr. WILKINSON.

Witness said he had read those portions of the Bills of the County Council and the South Metropolitan Company dealing with fittings. The South Metropolitan Company fixed a definite sum of 9d. per 1000 cubic feet to be charged for the fittings; whereas the County Council left the price to be settled by the Board of Trade after inquiry, and then, as a corollary, they would have to standardize the fittings. His conclusion was that it would be a better system that the Board of Trade should be empowered to fix the price to be charged for the fittings. It ought to be made clear that this was not a minor point, but a very serious matter. If the illuminating power was down to 14 candles, the extra quantity of gas required to give the same light as 16-candle gas in the argand burner would be 40 to 50 per cent. more, which would be equivalent to raising the price from 9d. to 1s. 1d. per 1000 cubic feet. If the quality was down to 12 candles, the quantity of gas to do the same amount of work in the burner would be no less than 100 per cent. more, so that the 9d. would be 1s. 6d. It was right that the Board of Trade should settle the price of the fittings, and also have power to revise the same.

Cross-examined by Mr. ROSTRON: Effective supervision of the charges by the Board of Trade would meet his view as well as the Bill.

This concluded the case for the County Council.

Evidence was then called on behalf of the Gaslight and Coke Company.

Mr. *J. W. Field*, examined by Mr. DANCKWERTS.

Witness said section 6 of the Bill compelled, without leaving any discretion to, the Board of Trade to fix for the use of meters and fittings such charge per 1000 cubic feet as they might think reasonable. It appeared that they had no alternative but to fix a definite price. He was advised that it would not be competent for the Board to say the price should not exceed so much. The Board of Trade, in 1876, arrived at the conclusion that to fix the price of a commodity in which there was no monopoly, by means of Public Commissioners, was an impossibility. Then in their report, the Select Committee of last year expressed the opinion that but little benefit would accrue to the public were they to attempt to dictate to the managers of the Gas Companies how they were to carry on their business; and further, that the principle of the sliding-scale, coupled with the auction clauses, was an excellent one, and should be maintained; and, lastly, that the prices charged by all the Companies for slot meters required regulation. Putting these together, the proper conclusion to come to was that the Committee thought that, on the whole, the price to be charged should not be fixed, but that some

sort of thing analagous to the sliding-scale should be applied—in short, regulation, not dictation. It would be quite feasible to devise a sliding-scale applicable to the capital embarked in the automatic fittings part of the Company's business. This part of the business, so far as the price was concerned, was already regulated by law; and indirectly, having regard to the limitation on the Company's dividends, it was regulated to some extent already under the sliding-scale. There was also regulation in the fact that if too high a price were charged, consumers would not adopt the system. The Acts which gave the Company a monopoly, fixed the top prices to be charged for that which was a monopoly; but in regard to the part of the business which was not a monopoly, the Companies had always had a free hand. Thus the rent for stoves was a matter of bargain between the Company and the consumer. At Liverpool and Portsmouth, there were Companies who not only let out stoves, but let out automatic fittings. These Companies were wholly unattached to the Gas Companies, who had declined to take up the business. It was quite competent for any Company to supply these things in London, in opppsition to the Gas Companies. If the Board of Trade, under the proposed new powers, were to fix too high a price for stoves and fittings, the Companies would be unable to compete with outside traders.

By the CHAIRMAN: At present, the Companies were forced to supply gas, if required, through a slot-meter, even if that meter were not furnished by the Company, provided it had been tested. The Companies were not under an obligation to supply a slot-meter.

Mr. DANCKWERTS: They are bound to supply ordinary meters.

The CHAIRMAN: Suppose a man says: "I want an ordinary meter." He knows, by Act of Parliament, what price he would have to pay per 1000 cubic feet. I say that where he prefers the slot-meter, he has no protection as to price. He can have a slot-meter on demand, but loses the parliamentary protection.

Mr. DANCKWERTS said that was not the case.

The CHAIRMAN: I put it to witness: If a consumer prefers a slot-meter what charge do you make?

Witness: I do not think we have such a case; but we should charge 9d. extra.

Mr. DANCKWERTS said the law was that a man must be supplied with gas at the market price. All the Company could do in the case of the slot-meters was to charge the ordinary price, *plus* 10 per cent. for the use of the meter.

The CHAIRMAN: Witness has answered me very satisfactorily. Up to March 27, the Company were getting 1s. 3d. for that for which they now obtain 9d. This means that they were securing before March 27 6d. more for the gas than they do now.

Witness: No; 6d. more for the fittings.

The CHAIRMAN: I say for the gas. Call it what you like.

Mr. DANCKWERTS (to witness): Though you are limited in your charge as to gas, you are entirely free as to the charge for fittings?

Witness: Yes; we are perfectly free to charge what we like. The matter is similar to the supply of gas-stoves.

The CHAIRMAN: No; it is quite different. It is not the same thing at all.

Mr. DANCKWERTS: In what way?

The CHAIRMAN: I have indicated that already. You are, practically, entering into a fresh contract which contains two elements, one of which is common to the old contract, and the other of which is new. In the liberty you possess to charge what you like for that new element (It is no use your shaking your head, Mr. Danckwerts, for you demonstrated the state of affairs on March 27), you can gain an advantage, and practically increase the price of gas.

Mr. DANCKWERTS: I am not entitled to argue with you; but may I be allowed to say this—that we compete with the ordinary tradesmen in the supply of fittings. If the consumer finds that he can hire fittings cheaper from us than elsewhere, he comes to us. If not, he would go to the tradesman.

Witness said that if a consumer were to dispute the charge, the Magistrate who would try the case would allow the ordinary market price for gas and the other part of the charge for fittings.

The CHAIRMAN: Have you a single case you can point to in which the slot fittings have been supplied by an ordinary tradesman?

Witness: No.

It could not be done?—With all submission to you, it is done in Liverpool. If the Company were compelled to supply every applicant with slot-meter gas, it would involve enormous outlay, and be very unfair to the ordinary consumer. The capital of the Company is already very heavy; and it would be a serious extra burden to have the obligation contained in this Bill imposed on us.

If the Bill passed, would the effect be to send up the price of gas?—I think it would have that tendency. Our capital would not return us the same amount of profit that it does now. The Company are not obliged to sell gas by means of the slot-meter.

Do you mean that, or is it a slip of the tongue? Do you state that a consumer cannot say to you: "I want your gas, but I wish it supplied through an automatic meter"?—No.

Therefore the whole of this new business is contingent and dependent on a separate contract made outside the parliamentary contract for an initial price of gas?—Not *quâ* gas.

Outside gas?—Yes.

You make your charge for these things outside your parliamentary duty. You charge 9d. *plus* 2s. 11d, which is the ordinary price of the gas?—Yes.

What I wish to get out is that you can, in your discretion, say: "Our price will be 3d. more or 6d. less for the fittings?"—Yes.

You could say that capriciously?—Yes; we could. But we are a trading Company.

And would not make fools of yourselves?—That is so.

You, in your discretion, say: "We will charge so much—1s. per 1000 cubic feet—for the apparatus; and now we will bring it down to 6d." In reality, it might amount to a differential charge for the gas itself?—It is open to that construction.

Mr. DANCKWERTS: Competition would prevent that.

Cross-examined by Mr. WILKINSON: The Gaslight and Coke Company had no competition in their district in the supply of fittings; but the working classes of London were as keen buyers as anyone. The Bill would put up the price of gas, because the obligation would be placed upon them to supply rich and poor under this costly system. He agreed, however, that the system was profitable.

By Mr. LEIGHTON: The automatic stoves and fittings were chiefly of the same pattern; so that when the system was once settled, it could be easily applied in a district. The £5000 loss consequent on the reduction in price, which followed the reduction in the South Metropolitan price, would have to be borne over the whole area of the Company.

By Mr. EMMOTT: He knew of no case in which there was competition with a Gas Company (beyond Liverpool and Portsmouth) in the supply of fittings. As to the extra charge made for automatic fittings, there were no parliamentary figures; but there was a return in the "JOURNAL OF GAS LIGHTING" a short time ago. It was, he believed, from 6d. to 1s.

The Committee then adjourned till yesterday (Monday).

HOUSE OF COMMONS COMMITTEE.

Wednesday, May 9.

(*Before Mr.* OLDROYD, *Chairman, Mr.* EMMOTT, *Mr.* STANLEY LEIGHTON, *and Mr.* NICOL.)

THE GASLIGHT AND COKE COMPANY BILL.

This Bill, the object of which is to enable the Company to raise additional capital by the issue of debenture stock, and to purchase and hold lands, came to-day before the above-named Committee.

Mr. POPE, Q.C., Mr. BALFOUR BROWNE, Q.C., Mr. BAGGALLAY, Q.C., Mr. DANCKWERTS, Q.C., and Mr. NEVILLE appeared for the promoters. The petitioners against the Bill were represented as follows: West Ham Corporation, by Mr. E. MORTEN; London County Council, by Mr. WORSLEY TAYLOR, Q.C., Mr. G. J. TALBOT, and Mr. BERNARD WILKINSON; the Corporation of London, by Mr. LITTLER, Q.C., and Mr. RIGG.

Mr. POPE, in opening the case for the Bill, said the measure was a very simple one which, under ordinary circumstances, would require very little explanation. But it came before the Committee under unusual conditions; and therefore he should have to go to some extent into detail. The Bill was promoted for the purpose of raising a sufficient amount of capital to enable the Company to discharge their statutory obligation to the public. It was an ordinary measure for raising additional capital, except that it proposed to raise the capital in a shape and form that was most beneficial to the consumers, and least advantageous to the shareholders. It was a proposal to raise £2,500,000 by means of debenture stock at 3 per cent., which stock was to be submitted to the public under the auction clauses, so that it could only be raised at the price which the market put upon it. The sole question before the Committee would be the requirements of the Company; for in no case would Parliament authorize the raising of an unreasonable amount of capital. The promoters were before Parliament last year with the same Bill, with the exception that when in the House of Commons they had asked for £3,500,000. They were there met by the London County Council, who said—and not without some show of reason—that this was a larger amount of capital than would be required to enable them for a reasonable period to carry out their obligations to the public; and the County Council had induced the House of Commons to reduce the capital in the Bill to £2,500,000. The Bill was now introduced as it left the House of Commons last year; the capital powers it contained being sufficient to enable the Company to carry on their undertaking for from six to seven years. Sir John Rankin's Committee, who had sat to consider the price of gas, had recommended that the reasonable period which new capital should cover would be five years; but he thought the Committee would see that there would be economy in dealing with the capital powers in respect of a slightly longer time. Parliament had always acted on the principle of giving capital powers for a period long enough for practical purposes, but not long enough to release the Company from parliamentary control; and this Parliament had done irrespective of any Special Committee's report. The Bill had been held back last year in the House of Lords until Sir J. Rankin's Committee reported as to the conditions under which further capital should be granted. But the House of Lords had then thrown out the Bill. Well, he submitted that it would not be fair to propose a variation of the standard price in connection with the sliding-scale, in respect of an application for capital which was not to be raised under the sliding-scale, but as debentures under the auction clauses. If the Committee altered the standard price of the sliding-scale, they would interfere with the conditions of the agreement between the public and the shareholders of the Company upon which between £12,000,000 and £13,000,000 had been raised. The learned Counsel described the sliding-scale arrangement; declaring that it was in the nature of a compromise, and had assumed the form of a most solemn contract. It would be quite contrary to parliamentary practice, and to justice, to disturb a solemn bargain simply because there was a requisition for more capital, which was not to be raised under the terms of the old bargain at all. Unless Parliament was actuated by a spirit of confiscation—which he could not believe was the case—they would not disturb the arrangement on which the capital of the Company had been contributed. In all instances in which new capital was to be authorized on terms which would involve a share in the parliamentary bargain, Parliament would be right in saying: "We will not sanction it on the old terms." But this was not the case here.

The CHAIRMAN asked what was the present standard price.

Mr. POPE said it was 3s. 9d. per 1000 cubic feet with a 10 per cent. dividend, and with ¼ per cent. addition or diminution of the dividend as the price rose or fell 1d. per 1000 cubic feet above or below the standard price. If once he satisfied the Committee that the Company wanted the money they asked for, and that they proposed to raise it in the most economical way in the interest of the consumers, and in a way which would not give those who supplied it the benefit of the old arrangement, it would not be fair for the Committee to put their hand to that old arrangement for the mere sake of gratifying the economic considerations which the County Council, on behalf of the consumers, had put forward. The questions for the Committee to consider were: Did the Company want the money? Were they going to raise it in an economical manner? And, in raising it, was it desirable that there should be

any interference with the terms on which the old capital of the Company had been raised? Another point was the recommendation in the report of the Select Committee, that the area south of the Thames, at present part of the district of the Gaslight and Coke Company, should be transferred from them to the South Metropolitan Gas Company; a fair and reasonable price being paid. The Company were quite willing that this area should be transferred to the South Metropolitan Company; but there was nothing, and there could be nothing, in the Bill about that, because the South Metropolitan Company were not buyers.

The CHAIRMAN: Could such a transfer take place without parliamentary authority?

Mr. POPE: I do not think so.

Mr. BAGGALLAY said the third paragraph of the recommendations of the Select Committee (referred to in the Instruction) about automatic meters, would more properly arise when the Committee were considering the second part of the London County Council Bill, which had been postponed, and was to be taken at the same time as the South Metropolitan Bill, which dealt with automatic meters, &c.

Mr. TALBOT said the view of the Council was that the way proposed for dealing with this question was in direct opposition to the recommendations of the Select Committee. He understood the Committee were asked to give the Bill, and then go on to the recommendations of the Select Committee. The Council held that the only method which would secure effect being given to the recommendations of the Select Committee was to take action when the Companies came for capital powers. The Committee of last year suggested that, when the Companies came for additional powers, their recommendations should be imposed as conditions precedent.

Mr. RIGG supported Mr. Talbot's contention.

Mr. POPE said Mr. Rigg misunderstood. He did not ask the Committee to pass the Bill irrespective of any question of conditions; but he did say this was not a convenient time to discuss the conditions. He was quite content that the Committee should keep hold of the Bill, and put upon the Company statutory obligations to carry out such conditions as they thought fit to fix.

The CHAIRMAN said the recommendations of the Select Committee seemed to hang one upon the other; and the Committee felt that they had better take the whole Bill before giving a decision as to capital powers.

Mr. POPE: I quite agree.

Mr. RIGG remarked that there was nothing in the Bill relating to the recommendations of Sir James Rankin's Committee; and his clients felt that, as the Company had deliberately set these recommendations at defiance, the Bill should not go forward in its present shape.

The CHAIRMAN said the Committee had in view the three recommendations of the Select Committee of last year, and would consider whether these were desirable before giving their decision.

Mr. *J. W. Field*, examined by Mr. BAGGALLAY.

Witness said he was Secretary and Manager of the Gaslight and Coke Company, the share capital of which, prior to the conversion authorized two years ago, was £9,204,000, and the borrowing power £2,539,000—a total of £11,743,000. The amount of ordinary capital to which the auction clauses applied was £1,000,000 of "A" ordinary stock; and in respect of this, they received as premium £1,078,700. Owing to the amalgamations which were carried out, there were eight or nine different classes of stock bearing different rates of interest. In 1898, the whole of the preferences were converted into one 4 per cent. consolidated preference stock, and the ordinary stock was converted from 10 per cent. standard stock to 4 per cent. stock; the amount of the new stock, in this case, being two-and-a-half times the former amount. All the stocks were dealt with under the conversion, except a sum of £130,000, the undivided profits of one of the Companies which had been amalgamated. This they were advised they could not deal with according to the terms of the bond. The conversion did not alter the amount of interest or dividend payable. The sliding-scale and standard was also altered to produce the same results in regard to the new 4 per cent. stock as they had in respect of the 10 per cent. stock. The preference, maximum, and ordinary stocks now amounted to £21,642,990, and the loan capital to £4,323,975; the former being 83½ per cent., and the latter 16½ per cent. of the whole. The unissued capital at the present moment was £250,000 ordinary stock and £200,000 loan. Practically, the Company's stock stood at no premium in the market. The proportion of loan capital to share capital was unusually low; the addition to the borrowing powers proposed in regard to the £2,500,000 would raise the percentage to 24 per cent. on the whole capital as fixed since the conversion. In addition to the actual sums raised by share and loan capital, the Company had received as premium on the ordinary stock £1,078,700, on preference stock £214,150, and on debenture stocks (to which the Company voluntarily applied the auction clauses) £310,200. The total amount actually raised by the issue of capital had been £13,463,550. The premiums had been used as capital, but bore neither interest nor dividend. The sums expended before the sliding scale came into operation had been: On works £5,670,823, on mains and service-pipes £2,165,885, on meters £210,299, and on sundries £102,132—making a total of £8,149,139. The expenditure from 1876 until 1899 had been: Works £2,842,653, products works and lands £261,867, mains and service-pipes £913,392, meters £363,208, stoves £320,576, and sundry accounts £25,980—showing a net expenditure during this period of £4,675,716. These two items, with £638,695 of floating capital, made a total of £13,463,550. The Company, on Dec. 31 last, had also borrowed from their bankers £125,000, and there was £193,000 undivided profit, which they had been using as working capital. The £125,000 was borrowed at 5·14 per cent., a high rate of interest, which showed the danger of a company having insufficient working capital. To secure the Company and obviate the necessity for borrowing, money beyond that referred to was needed, so as to prevent the coal store getting low. The Company's coal store in the past nine months, owing to the great stringency of the coal market, had been from 100,000 to 150,000 tons short. All things considered, a floating capital of £1,000,000 was needed at the present time. The capital expenditure which would be required for the present year was estimated at £257,000, which would leave, if they raised the whole of the uncalled capital, a small cash balance of £83,000. Witness proceeded to give the totals of the items for which the new capital was required, which his knowledge of the business enabled him to say were reasonable and fair, taken in connection with the expected increase in business. For gas-works, they wanted £1,720,000, mains and service-pipes £210,000, automatic meter supplies £375,000, ordinary meters £100,000, stoves £165,000, and products works £62,000—a total of £2,632,000. As regarded the item of automatic supplies, the gross expenditure would be £665,000; but from this a certain proportion was deducted which would eventually have to be borne by revenue. Therefore, in making the estimate for capital expenditure, a deduction of £290,000 to be spread over a number of years was made. Although the details were worked out by the heads of the departments, he had no reason to believe the figures were otherwise than correct. The item for automatic supplies was £375,000; and this was made up by taking £665,000, and deducting £290,000 from revenue in respect of house-fittings over which the Company had no control. They expected the whole of the sum would be written off in five years. During the last few years the progress of the Company had been very slow indeed; but in the past year there had been a large increase in business. If this increase was maintained, he thought the money asked for would last eight years.

Mr. BAGGALLAY: As to the proposal to raise the money by debenture stock, instead of by capital, was it discussed before you promoted your Bill last year?

Witness: Yes. The capital of the Company is very heavy, as compared with our business. Our capital is higher, I think, than that of any other Metropolitan Gas Company; and for this reason the Directors have proposed the present method of raising the new capital. We can get capital cheaper by 3 per cent. debentures than in any other way.

What is the saving that will be effected by this proposal, when the whole of the stock is issued?—As compared with the issue of ordinary stock, it will be £18,750 a year.

What is your capital in proportion to your annual million cubic feet output?—Before 1875 it was £870. It is now £650; showing a large reduction in 24 years. The corresponding figures for the South Metropolitan Company are: In 1875, £250; at present, £425. With the Commercial Company the figures are much the same.

What makes your capital higher than that of the other Metropolitan Companies?—In the first place, in 1868 we were compelled to transfer several of our works from London to Beckton—that is to say, we had to remove our manufacturing stations from London, and Beckton was the only place available. The extra cost of that has been £1,500,000. Then we are the only Company in London who have suffered materially by the introduction of the electric light. We have nearly all the clubs and theatres in our district, and we have the City and the large West-end shops. At all these places the electric light is used. But besides that, we have to maintain pipes capable of taking up the supply of gas at any moment.

Witness went on to specify other items of expenditure which fell more heavily on the Gaslight and Coke Company than on the other Companies. In consequence of the amount of their capital, they had to pay 3·46d. more; and they had to pay more in respect of the carriage of coal. Beyond this, they had been involved in large additional expenditure in consequence of the amalgamation of some eight or nine other Companies with them. Another item that had to be taken into consideration was the revenue from coke. Here they had one of the disadvantages of going to Beckton, which was a very isolated place, without a neighbourhood for the disposal of coke. As a result, his Company lost, as compared with the other Companies having town stations, 1·66d.; and they lost 1·4d. through their large consumption of carburetted water gas. Wages were higher under his Company by 0·63d., and rates by 1·16d. Then there were stove-rents and better prices for residuals to be considered; and the net result was a difference as against his Company of 3·54d. per 1000 cubic feet of gas, which had to be added to the 3·46d. in respect of capital. The gas supplied by the Company was of a uniformly higher quality than that furnished by the South Metropolitan Company. His Company used more enrichment than the South Metropolitan Company. In 1875, when the standard price was fixed, his Company were charging 3s. 9d. per 1000 cubic feet for gas, *plus* meter-rent; and the South Metropolitan Company were charging 3s., with no meter-rent. Then the standard of the South Metropolitan was fixed at 3s. 6d., or 6d. above the actual charge; and the standard of the Gaslight and Coke Company was 3s. 9d., or the amount of their actual charge. The Commercial Company were practically in the same position as the Gaslight and Coke Company. The present charge of his Company north of the Thames was 2s. 11d. per 1000 cubic feet, with no meter-rent; while that of the South Metropolitan Company last year was 2s. 1d., *plus* meter-rent. Thus the difference to-day was 9½d. per 1000 cubic feet—that was to say, the Companies had drifted together in the approximation of price during the whole period since 1875, to the extent of ½d. Witness went on to point out that the consumption of gas in the district of the South Metropolitan Company had increased at a much larger ratio than with the Gaslight and Coke Company. The increase in the number of consumers, in the case of his Company, had been 78 per cent., while with the South Metropolitan Company it had been 210 per cent., and with the Commercial Company 55 per cent. While the amount of the increase in the consumption of the South Metropolitan Company had doubled that of the Gaslight and Coke Company, the amount of the reduction in price of the one had rather less than doubled that of the other. In 1898, the number of Board of Trade units of electricity consumed in the Company's district was 35 million, the equivalent of which was 3500 million cubic feet of gas. The competition of the electric light in their district was absolutely different from what existed on the other side of the Thames. If his Company had had the consumption of gas which the consumption of electricity represented, their increase since 1883, instead of being 46 per cent., would have been 70 per cent. Taking the whole period from 1875, the increase, instead of being 117 per cent., would have been 153 per cent. He had considered the effects of the sliding-scale, as to the proportion which it gave to the consumer and the proportion which it gave to the shareholder, when any reduction in price was made. Taking the period 1881-1899, the value of the reductions in the price of gas made to the consumers amounted, in the aggregate, to £14,562,347. The earlier years before 1881 were affected by so many amalgamations that he could suggest no reliable figures in regard to them. In addition to this sum, the Company had abolished meter-rents, with a further benefit to the consumers of £300,000—making a total of £14,862,000. The extent to which the shareholders had benefited in the same period in

respect of reductions in price amounted to only £2,562,685. Therefore the predominant partner in the bargain had had nearly five times as much benefit from the operation of the sliding-scale as the shareholder. For every pound by which the consumer had benefited, the shareholder had received only 3s. 5d. The Company had inserted nothing in the Bill with reference to the recommendation of the Select Committee regarding the reduction of the standard price to 3s. 3d. per 1000 cubic feet carrying 10 per cent. dividend, with an increase or decrease of ¼ per cent. as the price was raised or lowered 3d. This was not a Bill in which it would be right to give effect to any such recommendation, which the Company read as applying simply to ordinary share capital subject to the sliding scale clauses, and as having no relation to a Bill for the issue of debenture stock subject to the auction clauses. Further, the Company inferred that the recommendation was not to disturb the existing bargain in relation to the sliding-scale. Paragraph 4 of the recommendation (which was not mentioned in the Instruction to the present Committee), that capital powers should not be granted to any company for more that five years, and that Parliament should revise the sliding-scale arrangement when such application was made, was held by the Company to apply to new capital, to which a new sliding-scale might be applicable. The determination of the Company to ask for debenture stock was made before the Select Committee of the House of Commons were appointed last year. With reference to the recommendation that the area south of the Thames which was at present part of the district of the Gaslight and Coke Company should be transferred to the South Metropolitan Company—a fair and reasonable price being paid for it—witness said that shortly after October last the two Companies entered into negotiations with respect to the transfer of that area and the Nine Elms works—basing their calculation on the amount of gross profit earned in the district and the value of the works. His Company made a definite offer to the South Metropolitan Company, who submitted an alternative proposal, which his Directors could not consider. As the South Metropolitan Company refused to refer the difference to arbitration, the whole question was allowed to drop. The third recommendation of the Committee, referred to in the Instruction, was that the charge made by the Gaslight and Coke Company for the rent of automatic meters and stoves should be the same to the consumers north and south of the Thames for fittings of the same quality and capacity. The Company were now charging the same; having taken the opportunity afforded a few months ago by an advance in the price of gas in the district of the South Metropolitan Company, to revise their charges. At present, the percentage of automatic consumers was 7·8 for the whole district. The Company's Bill as introduced this year was identical with the one of last year as it passed Sir W. Coddington's Committee, except a little alteration in the land scheduled. Also it was now proposed that the debenture stock to be issued should rank as a second debenture stock, immediately after the existing 3 per cent. debentures. Originally, it was proposed to make it rank *pari passu*; but the House of Commons authorities required it to be made a second debenture stock. The Bill further proposed to authorize the Company to hold certain lands which had been acquired by trustees for the Company; it being doubtful if the Company had power to hold them when they were acquired.

Cross-examined by Mr. Morten: The standard price of his Company was 3s. 9d. per 1000 cubic feet, and of the South Metropolitan Company 3s. 6d. He was aware that the South Metropolitan Company, by their Bill this year, proposed to reduce the standard price to 3s. 3d. per 1000 cubic feet, according to the recommendation of the Committee. If this proposal was accepted, the difference between the standard prices of the two Companies would be increased by 3d. This, however, had nothing whatever to do with the price charged. The present application to Parliament by the Gaslight and Coke Company was for additional capital. He did not know whether this was such a case as the Select Committee contemplated in their recommendation as to the Companies applying for an extension or alteration of capital powers.

Mr. Morten: The more gas you sell, the higher, you say, would be your total loss?

Witness: No; I do not say that. I referred in my evidence last year to reduction after the full statutory dividend had been paid.

Cross-examination continued: He did not recollect that in 1888 the Bromley Corporation, in their Improvement Bill, wanted to acquire some of the Company's land. It would have been most imprudent for the Company to have sold a foot of their land. The gas made at Silvertown was tested at the works. The gas supplied was of 17-candle power.

Cross-examined by Mr. Rigg, witness said Sir J. Rankin's Committee recommended that they should sell the part of their undertaking south of the Thames. If they did, no doubt that would throw fresh capital into the concern. The recommendation of Sir J. Rankin's Committee with regard to capital did not, in his opinion, apply to the raising of capital by debenture stock. The proportion of loan to debenture capital was not the usual one; but the disproportion was not a result of the stock-splitting which had taken place. The works for which the capital was needed must be put in hand almost immediately. The time the capital sought would last depended entirely on the rate of increase in the district. The Company had known an extension of works was necessary for a long time past; but the reason they did not come to Parliament before last year was that it was quite useless to do so when they had anything in their pocket. The only explanation he could give why the recommendation of the Select Committee with regard to capital was not included in the Bill, was that he did not think the recommendation applied to the issue of debenture stock.

Cross-examined by Mr. Talbot: The difference between the prices of the two Companies in 1876 and now was only about a farthing. He should be very much surprised to hear that the difference was 3¾d. in 1876, and was now about 9d. The sliding-scale in 1876 was imposed upon the capital created and to be created. It formed the subject of a parliamentary bargain. The price charged had never been up to the standard, or within 3d. of it, since 1876; and never since 1879 within 6d. of it. The last time the Company were in Parliament for capital powers was in 1876. The increase in the gas sold for the last ten years had been 19·6 per cent.; but any figures based on that as to what would be the increase for the next five years, would be fallacious, because the percentage had relation to years when, owing to various circumstances, the increase was low. He really anticipated that in the next ten years there would be a greater rate of increase than in the last; but that was purely a matter of opinion. The Company had about £450,000 of unexhausted capital power.

Re-examined by Mr. Balfour Browne: The Company had a public duty to perform—viz., to supply gas to every consumer in the district under penalty—and they could not continue to do this after the next year or two, unless they got the additional capital which the Bill proposed to raise at the cheapest rate possible, and therefore in the most advantageous way to the consumer.

Mr. Balfour Browne: The competition of electricity has curbed your development, at any rate?

Witness: Yes.

Is it a fact that your price has for twenty years been 6d. under the standard?—Yes.

During that time you have had to raise capital under the auction clauses?—Yes.

So the 6d. under the standard price induced people to come in and give higher premiums than they otherwise would?—Yes.

Would it be fair to touch the standard price and the capital subscribed on the strength of it?—It would be most disastrous to do so.

As I take it, the Committee who made the recommendations that have been referred to never intended anything of the sort?—They never said it. Witness added that the interest of the shareholders was to spend as little as they possibly could of this new debenture capital. It would all come before the stock on which the shareholders received the higher dividend. Their Silvertown works were now practically only used for the testing of coal.

Mr. Nicol: Mr. Pope has said that if the Committee think it desirable to confine the amount of capital to five years, the Company would, of course, bow to the decision. Suppose the capital is so limited, what amount of money would you require?

Witness: We should need from £1,500,000 to £2,000,000.

Mr. Balfour Browne, in reply to the Chairman, said that a fund for depreciation was only allowed by law in the case of gas-works on leasehold land.

The Chairman (to witness): Have you a reserve fund for the purpose of equalizing dividend?

Witness: We have not. In bad years, when coal has reached an abnormal price, we have postponed the making of a reduction in the price of gas.

Thursday, May 10.

Colonel *Makins*, examined by Mr. Baggallay.

Witness said he had been Governor of the Gaslight and Coke Company since 1872. He had been a party to the parliamentary settlement of 1876, under which the sliding-scale was laid down. Before the Act was passed, there had been one or two Committees to consider the matter, under Lord Cardwell and Mr. W. E. Forster; there having previously been a system in vogue under which, on the complaint of the representatives of the consumers or the request of the Gas Companies, a Committee was appointed to go into the question of the cost of the production of gas, and, having taken evidence, to fix such a price for gas for the ensuing year as would, provided due care and economy were exercised, yield 10 per cent. dividend. This resulted, practically, in a guarantee of 10 per cent.; but that guarantee was swept away in 1876, and the sliding-scale was substituted. The Act of 1876 was drawn up by agreement between the Metropolitan Board of Works (the predecessors of the London County Council), the Corporation of the City, and the Gas Companies, in the presence of the Board of Trade. A copy of the Bill was sealed by the Local Authorities and the Gas Companies. Power was reserved to the Board of Trade to call on the Gaslight and Coke Company to withdraw the Bill, if alterations were inserted without the consent of the Board of Trade. And, conversely, the Gas Company were to support—or rather, not to oppose—any Government Bill brought in by the Board of Trade to carry out the arrangement, in the event of the Company's measure not being carried. Not only did the Board of Trade initiate the Bill, so to speak, but they were the authority for carrying it out. The Metropolitan Board of Works, representing the consumers, were parties to the arrangement of 1876.

Mr. Baggallay: I will ask you whether the present proposals of the County Council and the Corporation of London, that new provision should be made with regard to the sliding-scale, and so forth (that is to say, if it is applied to any existing capital), is or is not in your opinion a request that the bargain made in 1876 should be altered as against one of the parties to it?

Witness: That all depends upon the reading of the first recommendation of Sir. J. Rankin's Committee. I do not know what the proposals of the Corporation and the County Council are. As far as I can see, they simply complain that we have not adopted the recommendations of the Select Committee of last year. I suppose they do not suggest we should have put into our Bill a new sliding-scale having a retrospective effect on the capital already existing. I do not see how we could be possibly supposed to do that, when we had issued, under the agreement of 1876, several millions of stock; for we set out in our invitations to tender, or when submitting stock to auction, the conditions which form the title-deeds of the shareholder. If we were to apply the new sliding-scale retrospectively, it would have the effect of at once knocking off 10s. per cent. The net result would be that the shareholders would have 10s. of their dividend taken from them, and carried to a fund for the purpose of reducing the price of gas. This would have the effect of reducing the dividend of the shareholder, to which he is entitled under the legislation of the present time; and he would get no compensation at all for that. He could not have his money back. He would simply lose the 10s. for ever; and he would also lose on the capital value of his stock from £12 to £15, which would mean a fine on the Company of £1,500,000 or £2,000,000. With regard to its being applied to new share capital, we have no objection to that. The new shareholder who came in would be perfectly aware of the terms on which he tendered or bought his stock at auction; and he would give a corresponding price. If we had brought in our Bill for share capital, we still should have asked the Committee to have fixed the same sliding-scale. It would have avoided two classes of stock, and the issuing of stock at a discount, which we should have had to have done had we applied for

share capital instead of debenture capital, and attached the proposed sliding-scale. Whatever the loss was, it would have to be borne by the undertaking as a whole—five-sixths by the consumers and one-sixth by the shareholders. Under the 1876 legislation, there is absolute identity of interest between the Company and the consumers. We cannot do anything which injures them, without injuring ourselves within the proportions; nor can any of our successes be more beneficial to us than they are to them. Continuing, witness said one of the conditions of the agreement of 1876 was the surrender by the Company of their right under the Companies Clauses Act to issue to themselves new capital, and the entering into an undertaking to sell it in the market—the premium (if any) to go into the undertaking. Now, if retrospective effect were to be given to any alteration of the sliding-scale, this would alter, as against one of the parties only, the terms of the settlement of 1876. It would be to place a penalty on the Company. It would transfer from one to the other a part of the profits which belonged to the shareholders. It was suggested by a member of Sir J. Rankin's Committee that the Company should at once reduce their price to the level of the South Metropolitan Company; and witness had to point out that this practically meant wiping out the Gaslight and Coke Company's dividend. One penny per 1000 cubic feet in the Company's district meant £82,000, of which the shareholders took £16,000, and the consumers, in the reduction of the price of gas, the remainder.

With regard to new capital, an alteration of the sliding-scale would be no interference with any bargain at all?—Not at all.

It would be merely a question of their issuing at auction the new capital on the basis of the new conditions, which would constitute a new partnership?—It would be merely a question of expediency.

The policy throughout has been to connect directly the interests of the consumer and the Company, with regard to the issue of the capital and the carrying on of the business of the Company?—Yes.

It must be so, because whatever money is earned by the Company, when it comes to be divided out, a large proportion has to go to the consumer and a small proportion to the Company?—Yes.

Before the shareholders can get a penny, they must have given five times as great an advantage to the consumers?—Yes. It would have been financial suicide if we had done anything but endeavour to carry on our undertaking in the most economical manner. We took the risk of dear coal and labour, but could not have contemplated the risk of having the terms of the old arrangement altered.

It is suggested that, in the preparation of their Bill, the Company have ignored the recommendations of the Committee of last year. Now, as to this, it is true, is it not, that you do not give effect to those recommendations?—Yes.

The Bill is the same measure as that you had prepared last year, before Sir James Rankin's Committee sat?—Yes.

Was there anything in your Bill, that you could see, by which you would have given effect to the recommendations?—No. They were referred to by the Committee as suggestions to enable the Gaslight and Coke Company to reduce the price of gas. We considered these suggestions, and could find in none of them any means of reducing the price of gas except by confiscation of property.

You think the new sliding-scale should not be applied to the existing capital. Your proposal is to raise all your new capital by means of debenture stock, in which case no new sliding scale could be adopted. Can you explain why you decided on debenture stock, and think it the most economical way of raising capital?—The feeling of the Directors was that the cheapest capital we could get was what we ought to apply for. The difference between 3 per cent. debenture stock and 4¾ or 5 per cent. ordinary stock, would be from £15,000 to £17,000 a year on the amount asked for; and this would be practically lost. I support the statement of Mr. Field in this matter. As to the working of the sliding-scale, the value of it to the consumer in reductions in the price of gas since 1881 has been £15,000,000; and the amount of extra dividend secured by the shareholders has been £2,500,000.

The CHAIRMAN: These figures represent the result that has been obtained under the sliding scale?

Witness: Yes.

The principles that have produced it are not in the sliding-scale itself, but in the conditions of the trade—the price of coal, and so on?—Yes.

And the sliding-scale shows to whom the benefit should go?—Yes.

Cross-examined by Mr. RIGG, witness said that his Company had considered very carefully the recommendations of Sir J. Rankin's Committee; and there were two interpretations to be placed on them.

Mr. RIGG: Who places two interpretations on them?

Witness: The man in the street.

What are they?—One that the proposed scale should be applied to existing capital; and the other, that when fresh capital is raised the new scale should apply to that.

Who is the author of the first interpretation?—Well, you crystallize it in your Bill. As to the other, it is obvious that the Committee could not have intended an act of injustice.

You contend that it would be unfair for the present Committee to interfere with the arrangement of 1876 in the interest of the consumer?—It would not be in the interest of the consumer, except *pro tanto* as an amount of penalty.

The bargain of 1876 was the result of a good deal of action on the part of the public, was it not?—It was the wish of the Board of Works to get rid of the yearly revision, which they found worked unsatisfactorily; and they wanted a system which would operate automatically.

The City Corporation brought in a Bill to buy you up, did they not?—Yes.

Then came the Act of 1870, which appointed the Revision Committee?—Yes.

The appointment of the Revision Committee was a bargain, was it not?—Yes; and it was a very valuable one to the Company, securing them 10 per cent. dividend.

And under it, you worked the price of gas up to 5s. per 1000 cubic feet?—We did not work it up.

But the Revision Committee put it up to that?—Yes.

And so dissatisfied were the public, that they brought in a Bill in order to enter into competition with you?—Yes.

And the existing "solemn bargain," as you call it, was put on you as the result of getting rid of these Bills?—The Board of Trade stepped in, and said: "Do not have this strife, but try and settle something;" and we did so.

The settlement of 1870 was interfered with?—At the request of all parties.

If Parliament could review the arrangement of 1870, which was between the consumers and the Company, why not review the bargain of 1876?—Parliament, of course, can do what it pleases. Mr. Kruger may blow up the Johannesburg mines, and stagger humanity. I think it would stagger humanity were a parliamentary agreement torn up.

Questioned as to whether, in the event of the sale to the South Metropolitan Company of the portion of the Gaslight and Coke Company's district on the south side of the Thames, he was prepared to maintain the Company's present obligations in regard to the public lighting on the north side, and accept a clause to that effect, witness said he thought he should not be asked that as it was purely hypothetical. The matter had not come before the Directors in any shape or form. The Company were prepared, as they ever had been, to treat the public authorities with the utmost consideration.

Cross-examined by Mr. TALBOT: Sir J. Rankin's Committee were an *ex parte* Committee in the sense of not being a judicial tribunal. They were appointed at the instance of the dissatisfied consumers among the public, who thought that the difference of price between North and South London ought not to exist. He did not use the term in any offensive sense. He objected to the procedure of that Committee, if the findings were to be considered as judicial, and to involve penalties. The Company had endeavoured to carry out the bargain made in 1876, in every jot and tittle. He did not think they had broken it in a single instance. The Company were proposing to carry out part of Recommendation 3 of the Select Committee (referred to in the Instruction to the present Committee), but not to give effect to suggestions that the prices charged for slot-meters required regulation. This they could not do. Consumers north of the Thames had never had gas at the same price as those on the south, and never, he thought, would have. He did not believe the agitation with regard to the Gas Companies was quiescent pending the results of the Committee of last year. This agitation always took place in the slack season; but it was baseless. It was absolutely impossible for the Gaslight and Coke Company, owing to their conditions, to produce gas at the same price as the South Metropolitan Company. There was a difference between the two Companies in 1876; and there was a similar difference at the present time.

Re-examined by Mr. BAGGALLAY: The recommendations made by the Select Committee with reference to the standardizing of the fittings of the automatic supplies, was a matter which was being brought directly before Parliament in Part III. of the Bill of the London County Council; and if dealt with at all, it ought to be dealt with in connection with all three Companies, so as to produce uniformity of standards and charges among them. This was the only way of dealing with the matter, because the Gaslight and Coke Company could not have introduced a provision in their Bill which would affect the other Companies. The Company's feeling was that this recommendation really was a Board of Trade matter. They felt that the House of Commons did not make these recommendations mandatory, because the Company never had the slightest opportunity of being heard upon them. They were made after the evidence had been taken; and the Company had no opportunity of pointing out how they were undesirable.

Mr. BAGGALLAY said the procedure in the House of Commons showed there was nothing wrong in the Companies thinking that the recommendations of the Committee of last year were open to consideration.

Further re-examined by Mr. BAGGALLAY, witness said if the confidence of investors were in any way shaken in the maintenance of the figures of the sliding-scale, it would affect the power of the Company to place capital at a premium; and this injury would be felt even more by the consumers than by the shareholders. The Company would not be able to issue share capital with the proposed sliding-scale, except at a considerable discount.

By the CHAIRMAN: In recent years, there had been considerable improvement in the manufacture of gas—as to the retorts, furnaces, use of carburetted water gas, &c. His Company had been somewhat dilatory in the adoption of these improvements, having been a little hard up. If they had been in easy capital circumstances, they could have considerably improved their machinery. The Company charged all replacements to revenue, and all extensions to capital.

Mr. *G. C. Trewby*, examined by Mr. NEVILLE.

Witness said he was Constructing Engineer to the Company, and had planned the whole of the extensions and alterations of the works during the last sixteen years. Out of the sum of £2,500,000 asked for, his department required £1,735 830. The previous expenditure of the Company on manufacturing and storage works had been economical and properly carried out. He had founded his estimates for the future upon an increase of 3 per cent. per annum compound, which, in view of past experience, he considered fair and reasonable. It would not be fair to estimate it at less than this. The money asked for would last for about nine years, on the basis of 3 per cent. increase. On the basis of increase for last year, it would be very much shorter. There was no reason why the increase of last year should not be maintained; and if it were, the money would not last more than seven or eight years. The sale of the Company for the year 1899 was 21,657 million cubic feet; and, taking the increase at 3 per cent. per annum for nine years, there would be an addition to the sale of 6601 million cubic feet—making a total of 28,258 million cubic feet. To this had to be added an allowance for unaccounted-for gas and gas used on works, making a final total, at the end of nine years, of 7005 million cubic feet, which would require manufacturing plant of 35 million cubic feet daily capacity. One of the chief difficulties in the enormous district of London, was to estimate what was the maximum quantity the Company might be called on to supply, as they had to provide at all times for what the public required. The largest amount sent out in one day last year was on Dec. 15, 130,829,000 cubic feet; and the largest amount sent out in any one week was 769,761,000 cubic feet. The largest provision of work available during last year to meet the demands was equal to the make of 830,000,000 cubic feet in a week, which left a margin of only about 8 per cent. The works it was proposed to erect were near the Royal Albert Docks Basin, and consisted of purifying-houses, retort-houses, a new dock,

and so forth. They would put up works at first to make 35 million cubic feet of gas per day. Storage works would also be erected. There would be two gasholders constructed, 3 miles from the Bromley works, to hold 12 million cubic feet of gas each; and there would be another holder constructed at Fulham—at the extreme end of the district—to hold 8 million cubic feet. It was proposed to adopt additional mechanical stokers at the Beckton works and elsewhere, and also to buy new pieces of land.

Cross-examined by Mr. RIGG: There were 14 retort-houses at Beckton now, one of which was a double one. The total manufacturing power at Beckton was 56 million cubic feet a day. They must take up the whole of the increase for London at Beckton; and this during the next nine years, at 3 per cent. increase, they estimated would necessitate a manufacturing capacity of about 35 million cubic feet per day.

Cross-examined by Mr. MORTEN, witness said the testing-station at Silvertown was at the Company's works. The other gas supplied to West Ham was not tested in the borough. It was tested in the City; but the City Corporation had no control over the matter.

By the CHAIRMAN: What terms are you under?

Mr. MORTEN: The Act of 1857, which provides for 12-candle gas. We wish to be placed under the Gas-Works Clauses Acts.

Mr. BAGGALLAY asked if the learned Counsel wanted something different to the conditions already existing in the Company's district.

Mr. MORTEN said he did not ask for exceptional conditions. The Company's Act of 1876 only applied to the Metropolis.

The CHAIRMAN supposed the Company did not propose to treat West Ham differently to the rest of the district.

Mr. BAGGALLAY said they did not. He should be glad if Mr. Morten would prepare a clause embodying the claim of West Ham.

Mr. MORTEN intimated that he would act upon the suggestion.

Mr. *G. F. L. Foulger*, examined by Mr. NEVILLE.

Witness said he was Distributing Engineer to the Company. They had eleven manufacturing stations and nine distributing stations, together with a number of governor-houses where the pressure was regulated. The amount of the estimate for new works in his department was £1,140,000, which would last eight years. The district was continually increasing in the suburbs; and this increase compensated for the loss of business owing to the use of electricity. The details of his estimate were as follows: High-pressure and trunk mains, £100,000; smaller or service mains, £55,000; new and additional wrought-iron service-pipes, £55,000; new meters, £100,000; gas-stoves, £165,000. Automatic supply: Meters, £320,000; cooking-stoves, £165,000; service-pipes, £180,000. This made a total of £1,140,000.

Mr. *Thomas Wilton* examined by Mr. NEVILLE.

Witness said he was Superintendent of the Chemical Department of the Company. The amount estimated for his department under the Bill was £61,000. This would last between eight and nine years.

Mr. *W. R. Herring*, examined by Mr. WILKINSON.

Witness said he was Chief Gas Engineer to the Edinburgh and Leith Corporations, and was at present engaged in rebuilding gas-works at Edinburgh. He was providing for the future wants of the district for 42½ years, taking the average increase on the demand at 3¼ per cent. per annum. They were immediately spending £750,000; and they expected to supply 50 million cubic feet of gas per day when the scheme was ultimately completed. He could confirm the figures put forward by Mr. Trewby, which he thought very fair. In his opinion, an 8 per cent. margin of gas in reserve was not sufficient, as it might be absorbed in one winter. A safe margin would be 20 per cent. reserve. So far as economy was concerned in these matters, it was desirable to look some distance ahead. It was useless patching together small pieces for a large undertaking. Proceeding in this way was costly and inconvenient.

Mr. WILKINSON: In Edinburgh, I believe, the competition between gas and electric light is very fierce?

Witness: That is so. The competition is not only in the shops and in the clubs, but in the tenements of the middle class. The charge for electricity is 3d. per unit. For gas, it was 3s. per 1000 cubic feet.

What is your experience of the increase in the supply of gas in a district where there is this keen competition?—We find that the average supply per consumer is greater now than it was before the introduction of the electric light. Generally speaking, electricity is bringing about an increased consumption of gas for lighting purposes alone, apart from the gas required for cooking and heating appliances. The public now seem to demand more light. We have not done much in the way of supplying gas for heating and cooking.

The CHAIRMAN: You think the consumers get used to a certain brilliancy, and want more light.

Witness: Yes.

Mr. WILKINSON: What is the increase in the gas supplied by you?

Witness: It is now nearly 6 per cent. per annum, in spite of the electric light. I think it would be unwise for gas engineers to estimate for a falling off in the consumption of gas; and I believe that this applies generally throughout the country.

This closed the case for the Bill.

Mr. MORTEN said the situation was perfectly plain; and the only question was how the Committee would say the Bill ought to be dealt with on behalf of the consumers. The facts were not in dispute; and the recommendations of the Select Committee put the Company in this position: After a long inquiry, certain findings and certain recommendations had been made by the Committee; and it had been an Instruction to the present Committee, in dealing with this Bill, to say how far effect was to be given to certain of these recommendations. The Company were in the position of people having to show cause; and the only way he knew in which they could have shown cause why effect should not be given to the recommendations, was to bring facts and figures pointing to different conclusions than those of the Select Committee. But beyond certain argumentative reasons, there was nothing fresh adduced to show why effect should not be given to the recommendations. The Select Committee found that the difference between the prices on the north and south of the river arose mainly, on the part of the Gaslight and Coke Company, from excessive capital charges, excessive working expenses, and the loss which the consumer north of the Thames had to bear owing to the gas being supplied to the consumer on the other side at a less price than it cost. The Company had not attempted to show that the findings were not justified. These being the reasons which led to the increased charge, the question arose whether it was to exist in perpetuity. The Company contended that this application to Parliament was not within the recommendation of the Committee; but the answer of Mr. Field, that this was an extension of capital powers, brought it within the very words of the recommendation, and made it an application which they said should lead to an alteration of the sliding-scale and standard price. There was no reason why the recommendation should not be given effect to. It was said the capital was to be issued in such a way as to benefit the consumer; and this was an observation which, as far as it went, was entitled to consideration. But how far did it go? The recommendation was that the standard price and sliding-scale should be altered with regard to the whole of the capital of the Company; and it was no reason why the recommendation should not be given effect to with regard to the whole of the capital, to say that the consumer would benefit by the issue of the new capital. It was suggested that the recommendation would do great injustice to the shareholders. If this were a private Company, there might be something in that; but they were dealing with a Company who had obtained a monopoly, and this made a great difference. The idea that the public should go on suffering from the difference in price, in order that the shareholders might continue to reap the advantage of it, ought not to prevail. Those who were responsible, by their past conduct and bad management, ought to be made to suffer. On behalf of the consumers of West Ham, he contended that the whole of the deliberations of the Select Committee would be thrown away unless effect was given to them; the main point being to secure a reduction in the standard price of gas. He did not want to deprive the Company of the capital necessary for the purposes of their undertaking; but if the Company were clearly told that Parliament would not give them further capital except upon the conditions in the recommendations, they would have to fall in with those recommendations, which were such as ought to be incorporated in the Bill.

Mr. LITTLER said the whole object of the City Corporation was to protect the gas consumer from annoying conditions of any kind, and to take care that whatever was done should not be done to the prejudice of the consumer. The Corporation had always felt that, in consequence of the amalgamations which took place, there would be economies and reductions of price effected. But this had not been the case; and the Gaslight and Coke Company were now charging a price higher than many small provincial companies. So far from a reduction being likely, with all this extra capital, it looked as if there would be an increase. Advisedly, and in the interest of the consumer, he asked the Committee not to allow this imperfect Bill to pass. He absolutely demurred to the proposition that the opponents should produce conditions; it being no part of their business to prepare a scheme for the Company. The promoters should have presented a workable scheme. Last year, in the Lea Bridge case, Lord Camperdown cut down the standard price by a third; so that all the sacredness of the standard price had been destroyed.

The CHAIRMAN: Was that in connection with an application for an increase of capital?

Mr. LITTLER: For an increase of capital, chiefly.

Mr. NEVILLE: The circumstances of that Bill were quite different from this.

The CHAIRMAN: What was the alteration in the sliding-scale?

Mr. NEVILLE: From 5s. to 4s. 6d. per 1000 cubic feet; and the Company had never once paid a standard dividend, or anything near it.

Mr. LITTLER: My point is that the sliding-scale has been touched.

Mr. NICOL: Does the sliding-scale, as carried out under the provisions of the Board of Trade, apply to other gas companies besides the three Metropolitan Companies.

Mr. LITTLER said the sliding-scale was invented for the Metropolitan Companies; and it had since been adopted in the four outside counties. The Company had not condescended to take the slightest notice of any of the recommendations of last year's Committee; and all the labours of that Committee would be wasted if the Bill were allowed to proceed without effect being given to the recommendations. The whole object of such an inquiry as that of last session was to get a basis for legislation. Parliament was absolutely free, especially since the decision of Lord Camperdown's Committee, to impose such conditions as they liked on the issue of new capital; the Companies being equally free, if Parliament imposed conditions which they could not accept, to go away without the capital, and do the best they could with their existing powers.

The CHAIRMAN: Seeing you are not going to call witnesses, and are relying on your speech, I should like to ask you if you can reconcile the first recommendation of Sir J. Rankin's Committee with the fourth. The first seems to be a precise and definite recommendation to attack the existing sliding-scale. The fourth appears to point in the same direction, but coupled with it is "either by way of increase or decrease;" and I call your attention also to the last line, "if the circumstances of the time or the conditions of the Company appear to require it." I should like to know your clients' views on these recommendations.

Mr. LITTLER: What we think is that, although every recommendation which is in favour of the consumer makes the matter more satisfactory than it otherwise would have been, and those recommendations are recommendations which we accept, they should have brought before you these proposals as part of their Bill, with the reasonable and necessary modifications. Notwithstanding all the recommendations, the Company came forward as if nothing had happened; and, under these circumstances, I ask the Committee to say the preamble is not proved.

Mr. TALBOT said he did not intend to call any witnesses, because, in the view of the London County Council, the subject had been very fully dealt with by the Select Committee. The County Council had been pressed to take action by practically all the Local Authorities within their district; these Authorities thinking they were not fairly treated by the Company, and that they were charged a price for gas for which there was no justification. The Council resisted the Bill of the Company before the House of Lords, because the Company sought by it to escape from parliamentary control for a long time and they were successful

in so doing, though their case had always been treated with contempt by Counsel for the promoters. The South Metropolitan Gas Company, on the other hand, had applied their minds to the recommendations of Sir J. Rankin's Committee, and had endeavoured to give effect to them in a Bill which would come before the present Committee later on.

Mr. NICOL: Mr. Field has given us the reasons why the Gaslight and Coke Company have not endeavoured to carry out the recommendations of Sir J. Rankin's Committee.

Mr. TALBOT said that was true; and if the Committee were satisfied with those reasons, well and good. Not only had the Company failed to carry out the recommendations of the Committee of last year; but in preparing their Bill, they had not even obeyed the injunction as to the length of time for which the capital ought to be provided. The Company had already been away from Parliament for 24 years; and it was difficult to believe that Parliament, when they gave the Company their capital powers in 1876, could have anticipated such a condition of things. As to the "parliamentary bargain," Parliament had undoubtedly reversed it in 1876; the sliding-scale having been hammered out as the result of a long contest between the Metropolitan Board of Works and the London Gas Companies. The Companies had agreed to the sliding-scale, for fear some worse arrangement should be imposed on them.

The CHAIRMAN: It was an arrangement arrived at outside Parliament; and as it was thought to be reasonable and fair, it was afterwards confirmed by Parliament.

Mr. TALBOT said that was the case; but Parliament had never anticipated that the sliding-scale was to be regarded as a part of the internal constitution of the Universe. He pointed out that, in the cases of the Lea Bridge and West Ham Gas Companies, the sliding-scale prices had been revised; so that the proposal of the County Council was not unprecedented. The Council had not thought it necessary to re-argue the case dealt with by Sir J. Rankin's Committee, though they had been prepared with evidence on the matter if it had been attempted to throw any new light on the decision of that Committee.

Mr. NICOL: You shelter yourself under Sir J. Rankin's Committee.

Mr. TALBOT: Yes.

Mr. BALFOUR BROWNE said that he had received a written statement from Mr. Littler, in which he said that he did not think the Lea Bridge case was an exact precedent.

The CHAIRMAN said it appeared to him that the fourth recommendation of Sir J. Rankin's Committee contemplated the revision of the sliding-scale in the case of every gas company.

Mr. BALFOUR BROWNE: I think that meant in the case of every Gas Company who were before the Committee.

The room was then cleared, while the Committee deliberated in private. On the re-admission of the public,

The CHAIRMAN said the Committee had decided to postpone the announcement of their decision upon the Bill until next Wednesday. He added that these Bills being so mixed, and the Committee being anxious to give a decision in each case in unison with the decisions in the other cases, was the reason they reserved their judgment. It was not that they wanted one Bill to influence their judgment in regard to another, but that they should not by their decision give rise to a conflict of interests, or stultify themselves, or give decisions which might seem inconsistent.

The Committee then adjourned.

LEGAL INTELLIGENCE.

THE FINAL STAGE IN THE SUTTON, SOUTHCOATES, AND DRYPOOL GASHOLDER CASE.

In the House of Lords on Monday last week, the appeal in the case of *Sutton, Southcoates, and Drypool Gas Company v. Jordeson* came up for the ratification of the arrangement arrived at between the parties and Lord James, to whom the matter was referred after the case had been debated in the House of Lords for a couple of days (see "JOURNAL" for Feb. 27, p. 545). It will be remembered that Mr. Jordeson is the owner of twenty-four dwelling-houses in Clyde Terrace, Hull; and he alleged that—in consequence of the operations carried out by Messrs. Holme and King, contractors in Liverpool, who were employed by the Gas Company to make excavations in preparation for the erection of a large gasholder on land adjoining his property—a subsidence had taken place, which had rendered his houses practically useless. Under a large portion of the town of Hull, there is a bed of what is known as running silt. This silt was encountered at a depth of about 16 feet, and it contained such a large percentage of water that the contractors found it impossible to prevent its oozing out from the land under the defendant's houses, which they were preparing for the reception of the gasholder. It was contended for the Company that they were acting within their statutory rights in erecting the gasholder, which had become necessary to meet the growing requirements of the town; and that they ought not to be held responsible for the damage, because they had not removed any of the soil under the defendant's property, and they were not liable for the escape of water. There was also a question as to the gasholder shutting out the light from Mr. Jordeson's houses.

The following is the text of the agreement arrived at, as ratified by the House of Lords (it applies both to the appeal of the Company *v.* Jordeson as well as to the appeal of Holme and King *v.* Jordeson): "The defendant Company having paid to the plaintiff sums together amounting to £3477, and the plaintiff having conveyed to the defendant Company the land and 24 dwelling-houses and other buildings thereon particularly referred to in the pleadings in this action, and known as Clyde Terrace, Sitwell Street, in the City of Kingston-upon-Hull: By consent let the Judgment of the High Court of Justice dated the 4th of August, 1898, and the Order of the Court of Appeal dated the 16th of May, 1899, and the injunction granted by such judgment be discharged, and let each party bear and pay their own costs of this action and of the appeals, including the costs of carrying out this order, and let all further proceedings in the action and appeals be stayed. And this order is to dispose of all claims between George Stephenson Jordeson, the Sutton, Southcoates, and Drypool Gas Company and Holme and King *inter se*, and being the parties to this action, whether for injunction, damages, costs, indemnity, or otherwise, arising out of the pending litigation or incidental thereto. And any of the parties are to be at liberty to apply to the Chancery Division of the High Court of Justice for the purpose of carrying this order into effect."

CENTRAL CRIMINAL COURT.

Monday, Tuesday, and Wednesday, May 7, 8, and 9.

(*Before Sir* FORREST FULTON, *Recorder.*)

Regina v. Norris—Serious Charge of Falsification of Accounts.

Frank Fairfield Norris (32) was indicted "for that he, whilst being a clerk, officer, and servant of the Frank Wright Prepayment Gas-Meter Corporation, Limited, did unlawfully, wilfully, and with intent to defraud, omit from the cash-book belonging to his employers certain material particulars." Other counts charged him with making certain false entries in the books and otherwise falsifying them.

Mr. MATHEWS, in opening the case, said that the prosecution alleged that on a number of dates between April, 1897, and June, 1899, the prisoner fraudulently falsified certain books of account the property of a limited Company called the Frank Wright Prepayment Gas-Meter Corporation, Limited; the prisoner during those years having been in the service of the Company and having had the duty devolved upon him of making true entries in the books. A great many figures would be presented; but, apart from the figures, he was justified in saying that the case was not without its interest. The broad issue as between the accusers and the accused was: On the part of the accusers it was said: "We being your masters and you our paid servant for the discharge of duties clearly defined, and perfectly known to you, you took our money for your own purposes, and used it, well knowing that it was our money you were using." On the other side, the answer given by the accused was: "No; nothing of the kind. I took no money belonging to you. It is true I did use the money which belonged to you, but I did not use it dishonestly. I paid it away on your behalf in regard to a number of secret service commissions of which you were perfectly cognizant at the time when I made the payments." This grave issue involved a strict examination into the truth of the answer given by the accused at the date of discovery; and for the purpose of showing, not only that the accusation was true, but that this answer was false, it was necessary to lay before the Jury what was the prisoner's conduct in the years 1897, 1898, and 1899, so that they might be able to gauge which side was speaking the truth—the accusing voice, which said of the prisoner: "You were engaged in a course of dishonesty, and you knew that the course upon which you were engaged was dishonest," or, the answering voice, which said: "Dishonesty! I was guilty of none. What I did was at your request, and for your service, because you will not confess that your money was devoted to purposes which will not bear the light of day, when once that light is thrown upon the matter."

The case was necessarily a very involved one; and a considerable part of the time of the Court on the second and third days of the hearing was occupied by the examination and cross-examination of the prisoner himself. The Directors of the Company stated emphatically that they never gave any authority for the payment of secret commissions, and had no knowledge whatever of any such commissions having been paid.

In the result, the Jury brought in a verdict of "Guilty;" and the RECORDER, in passing sentence, said he considered the line of defence adopted by the prisoner—making serious and grave allegations against everybody whose evidence was necessary to secure his conviction—aggravated his offence. It was rather a series of offences, extending over a period of years; and the prisoner had resorted to every kind of ingenious artifice for the purpose of evading the particular charges. The evidence was overwhelming; and the Jury could come to no other conclusion than they had done. He sentenced the prisoner to five years' penal servitude.

Unprotected Trenches.

In the Lord Chief Justice's Court last Thursday and Friday, a case was heard in which Mr. George Harrison, of Woking, claimed damages from the local Water Company in respect of injuries sustained by cycling into a trench on Oct. 14 last. It was stated that the trench extended some 10 ft. 6 in. into the road; and there was no protection of any sort, and no warning was given. The point of the defence was as to whether the plaintiff, who knew of the existence of the trench, and ran into it in broad daylight, admittedly without looking where he was going, was entitled to recover. The Jury awarded plaintiff £25. It was arranged that notice of appeal, if that step were decided upon, should be given within fourteen days.

Embezzlement by a Sheffield Gas Collector.

At the Sheffield Police Court, on the 2nd inst., James Edward Williams, until recently one of the collectors of the Sheffield Gas Company, appeared in the dock charged, on remand, with embezzling three sums of money from the Company. The prisoner admitted his guilt. Mr. E. W. Clegg, who prosecuted, said that the prisoner had furnished a list of defalcations during the past three months amounting to £386. His methods had been as follows: In order to get blank receipt forms into his possession, he had been in the habit of giving receipts for three distinct accounts on one form, and thus obtained two spare forms which he used for his own purposes. He had also collected large amounts from customers, of which he only paid a small part in to the Company. In one case, he received £19 1s., but only handed £2 to the cashier, and pocketed the balance. Williams had been for 27 years in the service of the Company, and had been a collector for 12 years at a salary of £175. He confessed to the Chief Accountant that he had been gambling very heavily. The Stipendiary committed prisoner for four months, with hard labour.

MISCELLANEOUS NEWS.

INTENSIFIED GAS LIGHTING IN LEEDS.

A substantial installation of intensified gas-lights (on the Somzée-Greyson system) has been made in the Town Hall Square at Leeds; and last Wednesday witnessed its inauguration. In all 21 lamps have been erected; and a very brilliant display indeed is made by them. Each lantern contains three burners, giving together a light equal to at least 750 candles; so that the light from the 21 lamps is equivalent to not less than 15,750 candles. The light from the old lamps previously in use round the Town Hall, only equalled 80-candle power for three ordinary burners; being one-ninth of the light obtained under the high-pressure system. The consumption of gas for each of the new lamps equals 30 cubic feet per hour, being 10 cubic feet for each burner; and taking the cost of gas at 2s. 6d. per 1000 cubic feet, the light of 750 candles per lamp only costs ⅞d. per hour. Therefore the whole cost of the 21 lamps per hour will only equal 1s. 6½d. From these figures, it will be seen that for the expenditure of a penny, a light equal to 860-candle power can be obtained under the intensified system; while for the same expenditure under the old method of lighting previously in use for the Town Hall lamps, only 160-candle power was given. The cost under the latter for an illuminating power of 80 candles was ½d. per hour. The installation was carried out by the Yorkshire Intensified Gas Lighting Syndicate. Being the first instance of the adoption by a municipal authority of high-pressure lighting on a large scale, it is worthy of special notice; and no doubt the Town Hall Square of Leeds will be a centre of attraction for Yorkshire gas managers for some time to come.

BOMBAY GAS COMPANY, LIMITED.

The Ordinary Meeting of this Company was held on Thursday, at the London Offices, No. 6, Drapers' Gardens, Throgmorton Avenue, E.C.—Mr. Robert Davidson in the chair.

The Secretary (Mr. J. Hill Perrins) having read the notice convening the meeting, the report and accounts for 1899 were submitted.

The Chairman said he thought, considering the circumstances that had existed in Bombay during the year, the accounts could not be regarded otherwise than very satisfactory. As the shareholders were aware, there had been in the city of Bombay a very severe plague, and in the Presidency a serious famine. In fact, he believed it was the most severe they had had; and the result had been that latterly many of the principal articles on which Bombay relied for exportation had been very much diminished in quantity. However, on the revenue side of their accounts, the receipts for private lighting were £3046 more, equal to an increase of 10½ per cent. upon the previous year's consumption, and which was the largest increase they had ever had. He was glad to say that for the first two months of the current year, the increase had been very well maintained. The revenue from the public lamps advanced by £700; and the return from the residual products was also satisfactory. At the last meeting, the Directors promised to separate the receipts for residuals and fittings; but he was sorry to say the matter had been overlooked in the preparation of the accounts. The total as per account was £15,801, which was a decrease of £777. The receipts for residuals amounted to £15,266; and for fittings to £520. On the expenditure side of the account, coal had cost more by £1500. An additional 277 tons had been carbonized; and, like everybody else, they had had to pay higher rates both for coal and freights. Hitherto they had shipped nearly the whole of their supplies from this side. But lately they had been enabled to use Indian and Japanese coal very largely; and this had resulted in considerable saving. If on further experience they were able to continue the free use of these coals it would be a great advantage to the Company. Among other things, they would be able to do with a much smaller stock; and thereby the risk of fire, from which they had suffered in past years, would be very much reduced. The item of wages was £120 more. A considerable number of retort-settings had had to be renewed during the last twelve months; hence there had been a large increase in the item "maintenance of retorts." There had also been an increase in trade and general charges, chiefly due to two or three special items—such as renewing retort-house roof, altering scrubber and washer connections, allowances in connection with the famine and plague, scraping lamp columns, &c. Salaries were £434 less; and passages and law charges also showed a decrease. Bad debts were only £14 more, notwithstanding the very anxious times through which they had been passing and the increased business. Exchange exhibited a loss of no less a sum than £15,089; each rupee remitted from India having produced 1s. 4⅛d., as against 1s. 4 $\frac{1}{32}$d. in 1898. During the year there had been more sickness among the staff, both European and native; and one of the sufferers had been their excellent Assistant-Manager, who had been attacked by small-pox. This illness among the employees must have caused their Engineer and Manager very much anxiety and extra work; and, under the circumstances, the results of the year's working must be considered most creditable to him. The available balance enabled the Directors to recommend a dividend of 3 per cent. for the half year (making, with the interim distribution in December, 6 per cent. for the year), and to carry forward, after placing a small sum to reserve, a balance of £400. He concluded by moving the adoption of the report and accounts; and the declaration of the proposed dividend.

Major W. F. Gordon seconded the motion, which was unanimously carried.

On the proposition of Mr. Charles Gandon, seconded by Mr. H. E. Jones, Major Gordon was re-elected a Director; and a similar motion by Mr. F. Lane Linging, seconded by the Chairman, returned Mr. Jones to his seat at the Board.

The Auditors (Messrs. E. A. Flinders and Magnus Ohren) were re-appointed on the motion of Mr. Gavine, seconded by Mr. F. R. Smith.

Mr. Whitley, in moving a vote of thanks to the Chairman and Directors, ascertained that the last information as to the illness among the employees was that there was a considerable improvement. He also commented upon the investment of the reserve fund in the works, and urged that, the greater the sum invested in liquid assets, the better it was for the shareholders. He saw they held £3330 in fixed deposits; and at the bankers, on deposit, and in hand, they had £9600, out of which about £7000 was going for dividends. So that, in round figures, they had only about £5000 invested in liquid securities. In regard to his motion, he was sure the Directors had the best interests of the Company at heart.

Mr. Gavine seconded the motion, which was passed unanimously.

The Chairman having responded,

A similar compliment was paid to the chief officials and staff; and an acknowledgment by the Secretary concluded the proceedings.

DUKINFIELD GAS DEPARTMENT.

The Past Year's Working.

The Engineer and Secretary of the Gas Department of the Dukinfield Corporation (Mr. Harrison Veevers) has presented his report on the past year's working. He states that the result is even more satisfactory than that of the year 1898 9; the profit being £1506, against £1074. The most striking points in the statement of accounts of the department are the large increase in the quantity of gas made, amounting to 6,787,800 cubic feet, or at the rate of 8½ per cent. over the previous year; the diminished yield of gas per ton of coal; the extra cost of coal; and the increased income from residuals, particularly coke and sulphate of ammonia. The decreased yield is due to the use of slack, through the scarcity of round coal. The difference between the gas made and that accounted for amounts to over 9 million cubic feet, or 10·8 per cent. Three years ago, before the commencement of the sewerage operations, the leakage was 3 per cent. less. The total loss of gas in that period will not be less than 7 million cubic feet. The works, mains, meters, &c., have been kept in thorough repair during the year. The use of prepayment meters is extending; the number now employed being 650, and the income from the gas supplied £849 7s. 11d., or equal to 7¼ per cent. on the total sales. The distribution of the gas made has been as follows: By ordinary meters, 69,306,016 cubic feet, or 81·3 per cent.; by prepayment meters, 5,485,750 cubic feet, or 6·4 per cent.; used at the works, &c., 1,312,834 cubic feet, or 1·5 per cent.; and unaccounted for, 9,197,200 cubic feet, or 10·8 per cent.—total, 85,301,800 cubic feet. The quantity of gas sold and used on the works was 76,104,600 cubic feet, as compared with 67,711,500 cubic feet in 1898-9; being an increase of 8,393,100 cubic feet, or at the rate of 12·4 per cent. The gross cost of production was 2s. 5·23d., and the net cost (exclusive of capital charges) 1s. 7·38d. per 1000 cubic feet of gas sold. The capital charges, amounting to 9·31d., bring the figure up to 2s. 4·69d. The average price of gas being 2s. 9·44d., the profit shown is 4·75d., as compared with 3·63d. in the preceding year.

BURSLEM CORPORATION GAS SUPPLY.

An Increase of 10d. per 1000 Cubic Feet.

At the Meeting of the Burslem Town Council yesterday week, Mr. Leigh, the Chairman of the Gas Committee, moved the adoption of the annual report and accounts. He said that the net amount received (to March last) for gas rentals, after deducting discounts, was £20,810, as against £18,575 the previous year; for meter-rents they had received £525, as against £525; for fittings £979, against £573; and for residuals (including stock in hand), £6584, as against £4557 - showing a very considerable increase. The gross receipts had been £28,910, against £24,232. So far as expenditure was concerned, the amount that coals cost last year was £8256, as against £6566 in the previous year—showing an increase for the year of £1689. These figures showed that the increase from residuals more than balanced the increased cost of coals. For carbonization they had expended £2198 last year, as against £1871, an increase of £327. For maintenance their expenditure was £3105, against £2304, or an increase of £801. For meters and mains the expenditure last year was £5098, compared with £3687 the previous year, showing an increase of £1410. The only other item of serious importance was the expenditure for interest. In the past year the charges for interest and repayments were £5036, against £4478, showing an increased charge of £558. In the previous year they charged themselves with the payment of £1028, being the completion of the purchase of the land with which the Council was familiar; while in the past year they charged themselves with the sum of £600 for the purchase of a building in the town, which the Council sanctioned some months ago, and the Committee thought it desirable to include this item in the past year's accounts. The figures he had quoted brought the actual expenditure for the past year to £28,999, as against £24,179 in the previous year; and the receipts for the past year being £28,910, a deficit was shown on the year's working of £89. But as last year, he observed again that they had excluded from their accounts the whole of the charges for public lighting, amounting to £2000, or rather more, inasmuch as they had during the past year had some increase in the number of lamps which had been put up. If they added to this sum the amount they had actually provided towards the purchase of the property he had referred to, the profits for the year amounted to nearly £2600, which, under the circumstances, he did not consider unsatisfactory. At any rate, it was an emphatic confirmation of the statement he made at a meeting recently, that it was altogether a misstatement to say that the profits of the gas-works were only £1000 a year. Mr. Leigh then proceeded to move what he described as a very important resolution, which he regretted it had not been possible to bring before the Council in the form of a minute, because the difficulty of arriving at a satisfactory recommendation had been rather greater than the Committee had supposed. The Committee's recommendations were: "That the price of gas be 3s. 6d. per 1000 cubic feet, less 2d. discount on accounts paid within a month; that 4d. discount be allowed in cases where gas-engines are used; that the rents of ordinary meters and gas cooking-stoves be abolished; that the charge for gas supplied through slot-meters be 3s. 4d.; and that the previous allowance of a penny in the shilling be discontinued." These recommendations represented an increase in the price of gas of 10d. per 1000 cubic feet net; and he was bound to point out that during the coming year they had to meet an

increase in the price of coals amounting to no less than £7000. It would have been more than this, but for the fact that during the past few weeks they had been able to obtain a small concession which represented a value of some £700 or £800 a year to the Council. He pointed out that the price of coal had actually gone up in three years nearly 150 per cent.; and it could not be considered dealing unfairly with consumers if, after such an increase in coal, they asked them to pay 33⅓ per cent. increase on the price of gas. Moreover, if the proposal was accepted it would put the Council in the same position as other public bodies owning gas-works in the district. The Burslem Council had rather prided themselves for some years past on the fact that they had supplied gas at a less rate than neighbouring bodies; but he might frankly state now that they had not been anxious to make public before—that they were really buying their coal at something like 1s. 3d. per ton less than even those who were purchasing on the most favourable terms. He did not quite know how this had happened; but he thought they might put it down to the business smartness mainly of their Manager. For the present, however, the situation was very materially altered. The gentlemen who controlled the association governing the price of coals in the district had determined that all consumers of gas coal must be placed on an equal footing. It would be seen that they proposed to surrender meter-rents; this being an important concession—more important perhaps in the sense that it removed what had been a more or less irritating charge in certain quarters. But they had gone a little farther than this; for the Committee had decided not only to discontinue the rents for the ordinary meters, but also to discontinue the charge for cooking-stoves. This would probably have the result of inducing an increased demand for such stoves. This concession represented an amount of £525 per year, or about 1d. per 1000 cubic feet of gas sold in the year. With regard to the automatic meters, they were simply reverting to what was the charge on their introduction—as a matter of fact, in future all gas consumers would be practically placed on the same level. There would be an additional discount of 2d. per 1000 cubic feet where gas was used for gas-engines. This was not at present a serious matter; but the Committee felt that it was desirable to induce the use of gas for this purpose as much as possible. One advantage was that gas for gas-engines was generally taken in the daytime; and if a large consumption for this purpose were brought about, it would be an advantage to the gas-works. The actual amount paid for principal and interest last year was £5036. If to this were added the £2500 he had already mentioned, they got the actual figure of £7500 as the gross profits on the gas-works trading during the twelve months. In conclusion, referring to one of the clauses in the Committee's report in which they undertook to follow the same course as that adopted last year—namely, to make no charge for street lighting in the borough—Mr. Leigh pointed out that if the town benefited by £2100 in this respect in the year just closed, if 33⅓ per cent. were the increased price of gas, if the Committee's recommendations were adopted, it must be clear that the town would benefit by an additional £700 out of the gas undertaking in the year to come.

After a few questions had been asked by members, and duly answered, Mr. Leigh supplemented his statement by giving the actual make of gas for the past year. This was, he stated, 199,147,000 cubic feet, against 177,329,000 cubic feet in the previous year, or an increase of nearly 22 millions. The gas delivered had been practically the same. The gas sold per ton of coal, was almost the same last year as in the previous year—being 9589 cubic feet per ton, against 9664 in 1899. The amount sent out through automatic meters was 25½ million feet in the past year, compared with a little over 20 millions for the previous year—showing that the automatic consumer was now a very important customer. For public lighting, confirming exactly what he (Mr. Leigh) had stated as to the individual charge placed upon them, they had taken 600,000 feet more for public lighting in the past year than was the case in the previous year, for which the town had not paid. The leakage last year was about the same figure as in the previous year—it stood at 9·1 per cent. as against 8·9 per cent.—the small increase being accounted for by the fact that they had had some serious breakages of mains owing to the disturbance of various parts of the district. Mr. Leigh, in answer to another question, said that the Committee recognized in the term "cooker" any kind of gas-cooker as distinguished from a gas-fire, for which they had previously charged a rental.

The recommendations and report of the Committee were then carried unanimously.

ELECTRIC LIGHTING NOTES.

A report recently presented to the Exeter City Council stated that the profit on the electric lighting undertaking last year was £1061. It was recommended that £550 should be placed to the reserve fund, and the balance carried forward; and this was agreed to.

On Tuesday last, a Local Government Board inquiry was held at Stockport in regard to an application by the Corporation for permission to borrow £23,468 for the purposes of electric lighting. The money is required for new feeders to supply important parts of the town.

The electric lighting works of the Barrow Corporation have now been working for twelve months. The revenue amounted to £2630; and a gross profit of £758 remains. Of this, £735 has been absorbed in interest; leaving only £22 towards redemption of loans. On the whole, the report is regarded as a very favourable one.

Bridgwater is promised a municipal electric lighting scheme which is to cost £15,000. A bare majority of the Town Council approved of the undertaking; but its opponents called a meeting of the ratepayers, and carried a resolution urging the Corporation not to proceed further with the scheme. The meeting was largely attended, and a deputation from it is to wait on the Council at the next meeting of that body.

In a report by Messrs. Medhurst and Kitchin to the Reigate Corporation on the question of lighting the streets by electricity, it is stated that the use of arc lamps as proposed would cost about £500 a year more than is now being paid for lighting the streets by incandescent gas-lamps; but that the effective light would be about six times as good. The Corporation have decided that "four" arc lamps shall be erected in the thoroughfares of the borough.

A good deal has been made of a statement by the Town Clerk of Canter-

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 1294.

Issue.	Share	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.	Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d.	£			p. c.	GAS COMPANIES.			£ s. d.
590,000	10	Apl. 11	10½	Alliance & Dublin 10 p. c.	20—21	..	5 0 0	60,000	5	Feb. 23	7	Ottoman, Ltd. . . .	5—5½	..	6 7 3
100,000	10	,,	7½	Do. 7 p. c.	13½—14½	..	5 3 5	500,000	100	Dec. 1	6	People's Gas 2nd Mtg. of Chicago Bonds	102—106	..	5 13 2
800,000	100	Jan. 2	5	Australian 5 p. c. Deb. .	102—104	..	4 16 2								
200,000	5	Nov. 15	6	Bombay, Ltd. . . .	6¼—6¾	..	4 8 11	851,070	10	Apl. 27	7	River Plate Ord.. . .	10½—11*	—¼	6 7 3
40,000	5	,,	6	Do. New, £4 paid .	4¼—4¾	..	5 1 1	250,000	Stk.	Dec. 29	4	Do. 4 p. c. Deb. .	100—102	..	3 18 5
880,000	Stk.	Feb. 23	12	Brentford Consolidated	250—260	..	4 12 4	250,000	10	Apl. 11	8	San Paulo, Ltd. . . .	11½—12¼	..	6 8 0
270,000	,,	,,	9	Do. New . . .	190—195	—5	4 12 4	135,000	Stk.	Mar. 14	10	Sheffield A.	246—247	..	4 1 0
50,000	,,	,,	5	Do. 5 p. c. Pref. .	140—145	..	3 9 0	209,053	,,	,,	10	Do. B.	244—246	..	4 1 4
159,375	,,	Dec. 14	4	Do. 4 p. c. Deb.. .	118—123	..	3 5 1	447,427	,,	,,	10	Do. C.	244—246	..	4 1 4
220,000	Stk.	Mar. 14	11½	Brighton & Hove Orig..	257—242	..	4 15 0	5,600,000	Stk.	Feb. 23	5½	South Metrop., 4 p.c. Ord.	122—124	—½	4 5 11
226,320	,,	,,	8½	Do. A. Ord. Stk. .	177—182	..	4 13 5	1,520,000	,,	Jan. 12	3	Do. 3 p. c. Deb. . .	99—101	..	2 19 5
999,500	Stk.	Feb. 23	5	Bristol, 5 p. c. max. .	125—130	..	3 16 11	380,940	Stk.	Nov. 30	5	Southampton Ord. . .	117—122	..	4 2 0
420,000	20	Mar. 29	10	British	39—41	—1½	4 17 7	70,825	,,	Dec. 29	4	Do. 4 p.c. Deb.	120—125	..	3 4 0
50,000	10	Feb. 23	12	Bromley, Ord. 10 p. c. .	24—26	..	4 12 4	120,000	Stk.	Mar. 14	6	Tottenham and Edmonton A. 5 p.c. B. 3½ p.c. 4 p. c. Deb.	139—141	..	4 5 1
79,000	10	,,	9	Do. 7 p. c. . . .	19—21	..	4 5 8	250,520	,,	,,	4½		100—102	..	4 8 3
500,000	10	Oct. 13	6	Buenos Ayres (New) Ltd.	9¼—10	..	6 0 0	55,100	,,	Dec. 14	4		113—117	..	3 8 5
220,000	Stk.	Dec. 29	4	Do. 4 p. c. Deb. .	99—101	..	3 19 3	182,380	10	Jan. 12	5	Tuscan, Ltd.	7—8	—½	6 5 0
150,000	20	Mar. 14	8½	Cagliari, Ltd. . . .	24—26	..	6 6 11	149,900	10	Jan. 2	5	Do. 5 p. c. Deb. Red.	101—104	..	4 18 2
100,000	10	Sept. 29	8	Cape Town & Dis., Ltd.	14—15	..	5 6 8								
50,000	50	May 2	6	Do. 6 p.c. 1st Mort.	55—57*	..	5 5 3								
550,000	Stk.	Apl. 11	13½	Commercial Old Stock .	275—285	..	4 14 9								
236,425	,,	,,	10½	Do. New do. .	210—220	..	4 15 5								
288,237	,,	Dec. 14	4½	Do. 4½ p. c. Deb. .	142—145	..	3 2 1								
800,000	Stk.	Dec. 14	9	Continental Union, Ltd.	160—170	..	5 5 11					WATER COMPANIES.			
200,000	,,	,,	7	Do. 7 p. c. Pref. .	175—180	..	3 17 9	780,399	Stk.	Dec. 29	11	Chelsea, Ord.	305—310	..	3 11 0
51,600	Stk.	Feb. 23	14	Croydon A 10 p. c. . .	335—340	..	4 2 4	160,000	,,	,,	5	Do. 5 p. c. Pref. .	157—162	..	3 1 9
173,400	,,	,,	11	Do. B 7 p. c. . .	265—270	..	4 1 5	160,000	,,	,,	4½	Do. 4½ p. c. Pref. '75	145—150	..	3 0 0
555,000	Stk.	Feb. 23	5½	Crystal Palace Ord. 5 p.c.	116—120	—1½	4 7 6	175,785	,,	Mar. 29	4½	Do. 4½ p. c. Deb. .	145—150	..	3 0 0
60,000	,,	,,	5	Do. 5 p. c. Pref. .	130—135	..	3 14 1	1,720,560	Stk.	Apl. 11	7	East London, Ord. . .	193—198	—2	3 10 8
486,090	10	Jan. 26	11	European, Ltd. . . .	19½—20½	..	5 7 4	654,740	,,	Dec. 29	4½	Do. 4½ p. c. Deb. .	145—150	..	3 0 0
354,060	10	,,	11	Do. £7 10s. paid .	14½—15½	..	5 6 5	890,000	,,	,,	3	Do. 3 p. c. Deb. .	99—101	..	2 19 5
14,993,075	Stk.	Feb. 9	4⅝	Gas-light and Coke 4 p. c. Ord. . .	99—101	—2	4 17 0	700,000	50	Dec. 14	7½	Grand Junction 10 p.c. max. .	104—106	—2	3 10 9
2,600,000	,,	,,	3½	3½ p. c. max. .	96—98	—1	3 11 5	310,000	Stk.	Mar. 29	4	4 p. c. Deb. .	130—135	..	2 19 3
3,799,735	,,	,,	4	4 p. c. Con. Pref.	118—120	..	3 6 8	708,000	Stk.	Feb. 23	14	Kent	307—312	..	4 9 9
3,993,975	,,	Dec. 14	3	3 p. c. Con. Deb.	97—99	—1	3 0 7	160,000	,,	,,	7	Do. New, 7 p. c. max. .	200—210	..	3 6 8
70,000	10	Nov. 15	8	Hongkong & China, Ltd.	13½—14½	..	5 10 4	1,043,800	100	Dec. 29	10½	Lambeth, 10 p. c. max. .	292—297	—2	3 10 8
3,800,000	Stk.	Nov. 15	10	Imperial Continental .	208—211	—2	4 14 9	406,200	100	,,	8	Do. 7½ p. c. max. .	208—213	—4	3 15 1
473,600	Stk.	Feb. 9	3½	Do. 3½ p. c. Deb. Red,	100—103	..	3 8 0	350,000	Stk.	Mar. 29	4	Do. 4 p. c. Deb. .	130—133	..	3 0 2
75,000	5	Dec. 14	6	Malta & Medn., Ltd. .	4½—5½	..	5 9 1	500,000	100	Feb. 23	13½	New River, New Shares	417—422	—1	3 4 0
560,000	100	Apl. 2	5	Met. of 5 p. c. Deb.	105—109	..	4 11 9	1,000,000	Stk.	Jan. 26	4	Do. 4 p. c. Deb. .	132—137	..	2 18 5
250,000	100	,,	4½	Melbourne 4½ p. c. Deb.	105—107	..	4 4 1	902,300	Stk.	Dec. 14	7½	South-wark and Ord. . . . 7½ p. c. max., 5 p. c. Pref.	198—203	—2	3 13 11
541,920	20	Nov. 15	3	Monte Video, Ltd. . .	10½—11½	..	5 4 4	126,500	100	,,	7½		187—192	—3	3 18 2
667,946	Stk.	Feb. 23	9½	Newc'tle & Gatesh'd Con.	215—220	..	4 4 1	489,200	Stk.	,,	5		160—165	..	3 0 7
299,855	Stk.	Dec. 29	8½	Do. 8½ p. c. Deb. .	104—107	..	3 5 5	1,019,585	,,	Apl. 11	4	Vauxhall 4 p. c. A Deb.	129—134	..	2 19 9
150,000	5	Nov. 30	8	Oriental, Ltd. . . .	7—7½	..	5 6 8	1,155,066	Stk.	Dec. 14	10	West Middlesex . . .	285—290	—2	3 9 0
135,000	5	,,	8	Do. New, £4 10s. pd.	6¼—6¾	..	5 6 8	200,000	,,	,,	4½	Do. 4½ p. c. Deb. .	147—152	..	2 19 3
15,000	5	,,	8	Do. do. 1879, £1 pd.	1¼—1¾	..	4 11 5	200,000	,,	Mar. 14	8	Do. 8 p. c. Deb. .	99—101	..	2 19 5
													*Ex div.		

bury, in the course of his report on the first year's working of the electric light undertaking of the Corporation, to the effect that there is a gross surplus for the year of £1913, on which "splendid result" he has congratulated the Council and the citizens. A correspondent to a local paper points out that after the interest and the sinking-fund charge, amounting together to £1507, have been met, there is left only £406. This is quite another story.

The Local Government Board have administered a snub to the Southampton Corporation. Sanction was recently asked to a loan of £55,000 for electric lighting purposes; but the Board have only complied with the application to the extent of £50,655. They have eliminated nearly the whole of the sum estimated for contingencies, and also £230 17s. 6d. described as the "amount paid as interest on stock previous to receipt of loan," as they do not consider this can be properly paid out of borrowed money. The Board also draw the attention of the Corporation to the fact that, while the works for which the previous loan was sanctioned have cost £7069 in excess of the estimated amount, a further sum of £34,088 has been expended upon large extensions of those works in anticipation of the Board's sanction, and without submitting to the Board any particulars of these extensions, until they were actually completed. The Board regard the action of the Town Council in this matter as most unsatisfactory, and trust it will not be repeated.

The "Leeds Mercury" does not always see things from the same point of view as the Gas Committee of the Corporation; but it must be credited with having rendered a service to the department by publishing the following: The Yorkshire House to-House Electricity Company, when bought out by the Leeds Corporation some eighteen months ago, were supplying about 75,000 electric lights in the city. The Corporation are now supplying 110,000 lights, an increase of something like 50 per cent. Of the 1500 customers, the majority use electricity for business premises. Between 300 and 400 houses in the Headingley and Chapeltown districts, however, have now an installation of electric light; and the demand in this respect is growing month by month. The celebrated electrician, Sir Wm. Preece, as a result of very careful investigation of this question, has come to the conclusion that 1000 cubic feet of gas is equivalent to about eight units of electricity. Accepting this calculation as accurate, then, the electric-light consumer of Leeds is paying as much as if he was burning gas at 3s. 4d. per 1000 cubic feet. As in Leeds the gas consumer is only charged 2s. per 1000 cubic feet, to get the same illuminating power from electricity he would have to pay 3s. 4d.

Our readers may remember that a Special Committee of the Salford Corporation have been investigating certain matters relating to the Borough Electrical Engineer (Mr. C. L. Turner). The Committee presented their report at the meeting of the Town Council on Monday last week. The principal charges against Mr. Turner were that he applied for a patent for work done by him on behalf and at the expense of the Corporation, and that there had been an unfortunate coincidence in the time of his securing a patent for pipework with the time when plans were being produced for contractors with the Corporation in his own department to tender for such work. The conclusion arrived at by the Committee was that Mr. Turner had endeavoured to mislead them and members of the Electric Light Committee on important matters of fact involved in the inquiry, with the result that he had lost their confidence. The report having been adopted, the Mayor (Alderman Rudman) moved a resolution to the effect that Mr. Turner be required to resign his position, and that three months' salary be paid to him in lieu of notice. Alderman Mandley moved, as an amendment—"That the Electrical Engineer be forthwith dismissed." On a division, the amendment was lost by 28 votes to 12, and the motion agreed to. It is reported that the Chairman of the Electric Light Committee (Mr. A. Haworth) has been threatened with legal proceedings; and the Council passed a resolution undertaking his defence in that event. Mr. Turner has written to the Town Clerk to the effect that, in justice to himself, he cannot resign.

A Local Government Board inquiry was held at Hull last Tuesday, by Colonel W. R. Slacke, R.E., in regard to an application of the City Council for sanction to the borrowing of £42,000 for electric lighting purposes. The Town Clerk (Mr. E. Laverack) stated that in 1891 the population of the city was returned at 200,044; while the present estimated population was 238,763. The annual value of the general district rate, to which the proposed loan would be charged, amounted to £775,192; while the borough rate was £951,000. The outstanding loans of the Corporation amounted to £904,083; and the period for which they now asked to borrow the money was 25 years—the same as before. They required the loan for extending the electric lighting works of the city. They secured their Order in 1890, and the first loan was obtained on Dec. 15, 1892, for £25,000. This was for the installation of electric lighting in what was called the Old Town. The works were opened on Jan. 16, 1893. They commenced with 33 consumers, and they applied for a second loan of £10,000 in respect of the same works on June 14, 1893. A further loan of £2800 was obtained on May 13, 1895; and another of £8000 on Nov. 17, 1895. This brought up to £45,800 the amount borrowed in respect of the original works. The 33 customers in the Old Town had increased to 488 in that area. They then found it would be necessary to erect additional works upon a much larger scale for the city generally—a new station, and a new system for an extended area on the high-tension principle, from which they could supply the rest of the town. For this larger work, they commenced with a loan of £40,690 on July 20, 1897; a second loan of £26,000 for extension was obtained on Jan. 2, 1899; and a further loan of £15,500 was obtained on March 13, 1899. Then came the £500 loan for a sub-station on June 24, 1899. This brought the amount borrowed up to the present to a total of £128,490. Now they were applying for an additional £42,000, which was necessary because of the increasing demand the Corporation had for light. This was a productive undertaking. Last year they had a balance, which might be termed absolutely clear profit, of £1924, and they proposed to carry it to the reserve fund. Up to the 31st of March last this fund amounted to £10,092. Already the sinking fund on the undertaking amounted to £11,546. They charged 5d. per unit for the ordinary supply of electricity, and 2½d. for motive power. Large consumers—viz., those upon whose premises there were more than 100 lamps of 16-candle power each—were charged 5½d. for the first hour and 2½d. afterwards. The total number of consumers now was 1326.

JOSEPH AIRD
GREAT-BRIDGE.
STAFFORDSHIRE.
TUBES
AND FITTINGS
GAS, STEAM, WATER GALVANIZED-TUBES, &c.
LONDON OFFICES: 46, QUEEN VICTORIA STREET, E.C.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The "Dunfermline Journal" of to-day gives a table showing the price of gas in fifteen towns in Scotland. In Dunfermline itself, which is not in the list, the price is 3s. 9d. The comment made upon the list is that "Dundee leads the way with an easy first; then Kirkcaldy breasts the tape with a good second; while Edinburgh and Aberdeen run a dead-heat for third place. On the other hand, Glasgow and Hamilton gas consumers are to be congratulated on being supplied with an article at the lowest price possible." This is simply nonsense. I observe that the list comes down to a town in which the consumption of gas is 42 million cubic feet a year. But there are others, in which the consumption is more than 42 millions, where the price is higher than in Dundee. I do not know upon what principle the selection has been made; but, inasmuch as it is not complete, it is of no value. Even if it had been complete, in respect of the correct towns to select, there is no utility in stringing together a number of places and saying that the charge in them is so much, or so little, without taking into account antecedent and surrounding circumstances. No attempt of that sort is made in this case. Perhaps the publication may serve its purpose better without explanation than with it—this purpose being to lead the people of Dunfermline into the belief that they pay more for their gas than anybody else. It is not correct to say so, or even that of towns with a gas consumption of over 42 million cubic feet yearly, Dundee at 3s. 4d. per 1000 cubic feet, or even Dunfermline at 3s. 9d., are the highest. The whole thing is so unjustly invidious, and so useless to boot, that I refrain from giving the names of the places.

The annual meeting of the Lochore and Capledrae Cannel Coal Company, Limited, was held yesterday. The dividend declared for the year was at the rate of 10 per cent.; and the sum carried forward was £1595. This is not evidence, by any means, of exorbitant earnings; but it has to be remembered that the high profits will only begin now to be realized. Coalowners who were working out contracts have not, in many instances, reaped much benefit from the rise in the market. Now when they enter upon new contracts, they will. The question which is in the mind of everyone outside coal circles is whether the rise in price has not been more than commensurate with the situation. I think I am safe in saying that the universal answer to the question is that it has been. The idea that coalowners had formed themselves into a ring to inflate prices, which was at one time widely held, has now been given up, as it is seen that outside circumstances have been such as to warrant the rise. I would be inclined to believe them were they to say that it was the public themselves who raised the price of coal, by offering the higher rates. To owners of mines the high prices mean fortunes, if they keep up; but it must not be forgotten that to those who are merely dealers in coal, they mean something else. They, too, may be coining money, if they can buy and sell skilfully; but if they cannot do that, ruin will soon be their portion. Doubtless the high quotations which are now being received by purchasers are being made by sellers with a view to cover any mistakes which may be encountered in the course of the season. This almost may be assumed right off; but, taking these considerations into account, it is the case that the public, including gas producers, are paying more for coal than they need to, if only they could help themselves. Miners are now paid for their labour on an arrangement of the nature of a sliding-scale. I have said before that there is nothing, in my opinion, to prevent large purchasers of coal from endeavouring to secure that their contract prices should be fixed on somewhat the same lines. The difficulties in the way of such an arrangement are the foreign demand, and the competition among home consumers. The former cannot be dealt with, but can only be reckoned with; the latter could be overcome by combination. There is no such thing at present; and meanwhile large contracts are being entered upon by purchasers in a state of helplessness. The great contract for the Glasgow Corporation Gas Department is at present under consideration; and the public are being reminded, with a frequency which points to the great interest that is taken in the matter by journalists more or less irresponsible, that the prices will be up, on an average, by 5s. per ton. I will be cautious, and will express no preliminary opinion on the subject, because it would do no good. I have spoken of skill in purchasing, which is an attribute that I cannot eliminate from my mind when I think of Mr. Foulis's knowledge of the ins and outs of the business, and reflect upon the capabilities that are in his hands, in the magnitude of the orders he has it in his power to place and the many sources which he may draw from. But if gas managers and other large purchasers of coal have no combination, it is otherwise with the coalmasters. In the matter of looking after their interests, they have the faculty of, at any time, becoming a unit. They have already appeared, by deputation, before the Board of Trade in London. Yesterday they had a meeting in Glasgow upon the same subject—the increased charges by the Railway Companies for the conveyance of coal. It is reported that, as no settlement had been arrived at, it was resolved to proceed with a case before the Railway and Canal Commissioners. By no "settlement," of course, is meant that the Railway Companies have not agreed to withdraw the increase upon their charges. It appears to me that the coalmasters are too voracious. The increase upon the railway rates is only about 3d. per ton, and the miner does not get more of an increase upon his wages; and when the rise in price is several shillings per ton, I think it will occur to most people that the public, and not the coalmasters, are paying the increased rate.

It may be well to look to the future for a little, and particularly to take note of an element which, no doubt, is already being anticipated by coalmasters as a probable source of trouble. At present they and the miners are working hand in hand; but how long can such a state of matters be looked for? When the representatives of the miners come next to audit the books of the collieries, and find out how great the profits have been, is it to be expected that a demand for a very large increase of wages will not be made? Should such arise, any increase which might be given would have to come out of the pockets of the coalmasters, because any attempt to further raise the price of coal to the public would lead to the importation of coal on the one hand, and a lessened consumption on the other. The possibilities, in this view of the situation, are, therefore, the

RICHMOND & CO.,

LIMITED,

LONDON, WARRINGTON, & STRATFORD.

Send us your Enquiries for all kinds of

GAS COOKING APPARATUS.

PROMPT ATTENTION.

alternative ones of a severe struggle with the miners or working at a loss. To many of the coalowners it would, in either event, happen that the hay which they are making in this period of sunshine would be all consumed. The present arrangements with the miners terminate in the autumn. When that time arrives, new conditions will come into play; and, so far as appears, the conditions will not be so favourable to the coalmaster as are the present ones. Will the public fare any better then than now? They cannot well fare much worse. The circumstances would seem to point to a certain number retiring from business to live upon the proceeds of the large prices, rather than lose them in fighting, and to there being a rush to take their places, followed by reckless speculation, broken contracts, litigation, bankruptcy proceedings, and the like, in the course of which untoward events the market would be cleared of the unfittest. But before then, these would have made a bold bid for existence by cutting prices; and thus it is open to entertain the belief that the public will, in a short while, again have coal at a reasonable rate.

At a meeting of the Fife Lunacy Board this week, it was stated that a Sub-Committee had met a deputation from the Cupar Gas Company regarding the supply of gas to the Lunatic Asylum. At present, it is attempted to light the place by means of a main which runs direct; but, as may be supposed, the service is unsatisfactory. The Gas Company have, however, offered to erect a small gasholder at the Asylum, which could be filled during the day, and from which a plentiful supply could be drawn at night. The charge for the gas would be 6d. per 1000 cubic feet higher than to consumers in the town. The Chairman of the Board admitted that the Gas Company had gone a long way to meet them; but as that was the last meeting of the present Board, he was in favour of the subject being left to the new Board. As to the proposal to erect a gasholder at the Asylum, I may say that I know a place where a similar arrangement exists—for the supply of an asylum, too—and it does not give entire satisfaction. The reason is that it must be left to someone at the asylum to admit the gas into the holder; and it is found, in practice, that this person does so irregularly. He may let his holder almost run down, and then suddenly, at about the time of lighting up, begin to fill it. The drain upon the town holders is thus often too much—necessitating an anxious time to keep up the town supply. If a plan could be found by which it should be possible to charge the distant gasholder at will, the method of supply would work with entire satisfaction; but I am led to understand that such an arrangement does not exist.

The "North British Daily Mail's" man on 'Change calculates that it will cost the Glasgow Corporation Gas Department £120,000 to £130,000 more for coal next year than this; and he considers that a rise in the price of gas will be necessary.

It is reported that there are up to date twelve applications for the post of Engineer and Manager to the Perth Gas Commission. The time for lodging applications expired on Thursday.

The undertaking of the Dunoon Gas Company is to become the property of the Municipality of the town on the 15th inst. Negotiations have been in progress in the usual way, under the Burghs Gas Supply Acts, for the fixing of the price. These have now been completed; and the price is £31,051. The capital of the Company is given as £18,000.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *May* 12.

Sulphate of Ammonia.—The market has again been quiet; and the closing quotations are £11 3s. 9d. to £11 7s. 6d. per ton, delivered f.o.b. at the ports. Considerable quantities being in course of shipment at the Scotch ports, and available supplies being consequently limited, full prices have been obtainable at these points. Elsewhere supplies have been sufficient, and values have scarcely been maintained. In the forward position, inquiry is mainly for delivery over the summer months; but the firmness of makers hinders business. London (Beckton terms) is quoted £11 5s. per ton. But there is speculative offering abroad at below the equivalent of this price; and Continental producers are also selling at a discount.

Nitrate of Soda is steady at 8s. 4½d. per cwt. for ordinary, and 8s. 7½d. for fine, quality on spot.

LONDON, *May* 12.

Tar Products.—There is a better inquiry for benzols, particularly for 50's quality, and slightly better prices are obtainable. The production of benzol has fallen off rapidly during the past few weeks, which has doubtless helped the position materially. Carbolic acid is quoted higher. Buyers seem anxious to book business for forward delivery. Solvent and heavy naphthas still show a dull market. Pitch is firm; and naphthalene, either in the form of creosote salts pressed or dried, is quotable somewhat firmer.

The following prices mark the average business of the week: Tar, 17s. 6d. to 27s. 6d. Pitch, east coast, 38s.; west coast, 35s. Benzol, 90's, 6d.; special qualities for gas, 8d.; 50's, 8½d. Toluol, 90's, 1s. 1d. Solvent naphtha, 1s. 1d. Crude naphtha, 3½d. Heavy naphtha, 1s. Creosote, 2½d. Heavy oils, 3½d. Carbolic acid, 50's, 2s. 6d.; 60's, 3s. Naphthalene, 55s. to 75s. Anthracene, "A," 4d.; "B," 3d.

Sulphate of Ammonia.—The position has not materially changed for the better; but there are indications that the slump in value has been arrested. Some rather important business is noted; and there are many buyers who would pay above £11 per ton for prompt or immediate forward delivery. Makers, however, will not sell under £11 5s., less 3½ per cent.; but the average value at the various ports might be taken at £11 3s. 9d.

The Wath and District Gas Company's Provisional Order.—At the meeting of the Wath Urban District Council last Wednesday, a letter was read from the Board of Trade with reference to the application of the Wath and District Gas Company for a Provisional Order, in reply to one from the Clerk, pointing out that the maximum price mentioned in the Draft Order was 5s. instead of 4s. 2d. per 1000 cubic feet, the amount recommended by the Commissioner at the recent inquiry. The Board of Trade letter stated that 5s. had been inadvertently inserted for 4s. 2d.; and that they were taking the necessary steps to have the clause altered accordingly.

SAWER & PURVES,

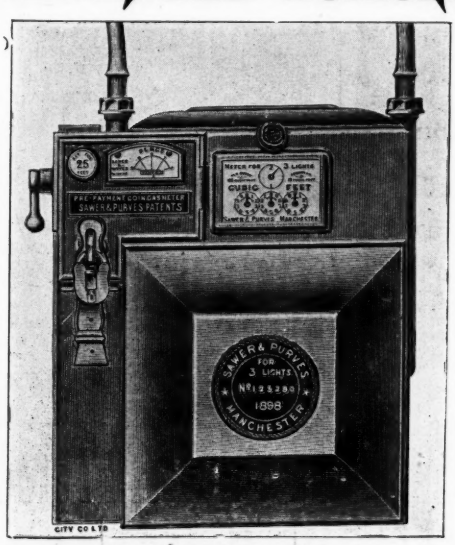
(BRANCH OF METERS LIMITED),

Telegraphic Address: "SAWER, MANCHESTER." NELSON METER WORKS, MILES PLATTING,

National Telephone: 3289 MANCHESTER. **MANCHESTER.**

Makers of Meters fitted with

PATENTED Detachable Prepayment Attachment.



Meter in working position.

Meter with attachment removed without uncoupling

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—If there is any change to report in connection with the coal trade of this district, it is that the position is perhaps not quite so strong as it has been of late. The house-fire demand is now unmistakably falling off, with the result that the better qualities of round coal are becoming more plentiful on the market, and helping to relieve some of the pressure on the lower qualities for steam, forge, and general manufacturing requirements; while deliveries to gas-works are dropping down to about their minimum quantities. Although it cannot be said that this generally easier position as regards supplies has any appreciable effect upon prices, it is somewhat significant that the Lancashire coal-owners have not considered it advisable to enforce the decision of three weeks back to hold out for a minimum advance of 6s. per ton over last year's rates on the ensuing twelve months' railway contracts for locomotive fuel. Almost immediately after the resolution had been passed, it became known that several collieries outside the Lancashire Coal Sales Association were either in negotiation for, or prepared to accept, contracts at an advance of 5s. per ton over last year. This has since been accepted as the basis by the Lancashire Coal Sales Association; and tenders have been sent in to the railway companies at an average of 13s. per ton at the pit, which is 5s. over the 8s. contract basis of last year. This puts the advance on locomotive fuel and gas coal on the same level, and may be taken as representing the minimum basis that will be firmly held to on both the above classes of fuel. In fact, the railway companies have already signified their intention of closing their contracts at 13s. per ton; and the gas coal contracts that have so far been settled have also been on the basis of 5s. per ton over last year's prices. For steam and forge coals, the demand generally is fully maintained; and much the same applies to engine fuel, which, notwithstanding extra supplies just now coming in from Staffordshire, continues scarce at most of the Lancashire collieries. Pit prices are practically without quotable change; ranging from 12s. 6d. and 13s. 6d. per ton for the lower descriptions to 14s. 6d. and 15s. 6d. for the best qualities of round coal, with engine fuel 10s. 6d. to 11s. 6d. according to quality. The shipping demand is moderate; but the official minimum basis of 16s. per ton for steam coal at the Mersey ports is now scarcely more than nominal; 15s. 6d. to 15s. 9d. representing about the full average figures. The pressure for coke continues, and no difficulty is experienced in getting the recent advance. Ordinary furnace cokes readily sell at 24s., and the best foundry cokes at 32s. per ton at the ovens.

Northern Coal Trade.—There is an increased demand for coals, both for steam and for Durham kinds, except where the non-arrival of steamers temporarily interferes with the shipment. The opening out of the Baltic means a very large increase in the demand for steam coal. Best Northumbrians are firm at about 19s. per ton f.o.b.; while steam smalls are still rather scarce, and command about 13s. For gas coals, the prices are well adhered to. For occasional cargoes of best Durham gas coals, rates quoted vary from 17s. to 17s. 6d. per ton f.o.b.; and in one or two instances a higher price has been paid for special kinds and for prompt delivery. Most of the large contracts for gas coals that have long been pending are now decided on; and it is believed that the average range of prices to be paid will be about 16s. per ton f.o.b. Coke is still very firm, both for export and for home consumption; best Durham coke being 35s. per ton f.o.b. There is no change of moment in the price of gas coke this week; but the output is rather less, and stocks are limited. It is anticipated that higher prices will be asked for gas coke, to meet the advanced rates that must be paid for coal.

Scotch Coal Trade.—There is no change in the market, but the effects of the great rise in the price of coal are beginning to be felt, and the public are disposed to grumble. The high prices are still maintained, and are likely to be for some time. The quotations are: Main, 14s. to 14s. 3d. per ton f.o.b. Glasgow, ell 15s. 3d. to 15s. 6d., and splint 14s. 9d. to 15s. The shipments for the week were 216,952 tons—an increase of 3216 tons upon the previous week, and of 21,712 tons upon the corresponding week of last year. For the year to date, the total shipments have been 3,425,001 tons—an increase of 775,504 tons upon the same period of last year.

The Gas and Water Finances of Loughborough.—The Loughborough Town Council have decided to adopt a suggestion by the Local Government Board to raise the amounts required for their undertakings during the next twelve months by mortgages at short terms; and the Town Clerk has been instructed to borrow £103,000 for the purposes of the gas undertaking, and £34,000 for the water-works.

Local Authorities and Incandescent Gas Lighting.—Gas continues to compete very successfully for the purposes of street lighting, particularly in those towns where electricity is in the hands of the Municipality. The Bradford Corporation, for instance, who supply electricity at as cheap a rate per unit as almost any town in the country, have just fixed several thousand Welsbach burners in their street-lamps, having had practical experience of the economy resulting from upwards of 1000 burners already in use. The Huddersfield Corporation, who also possess their own electric lighting works, are now largely extending the Welsbach light. The Tunbridge Wells Town Council have decided to fix 350 incandescent burners in the street-lamps, instead of extending the electric lighting, which is a municipal supply. Therefore they find it more economical and efficient to purchase gas from a Company than to sell themselves their own electricity. One of the best installations of incandescent gas lighting in the country will be that on the sea front at Hove. Hove, as everyone knows, has the best of the sea-front as compared with Brighton; but, up to now, its parades and promenades have been very inadequately lighted, while Brighton boasted of a row of arc lamps. Hove is now installing Welsbach burners; and its sea-front will soon be better lighted than its rival. Among the many other towns which have recently adopted the system are Maidenhead, Dukinfield, and Hemel Hempsted. Small towns, as a rule, are very badly lighted, as the local authorities grudge the cost. They, however, find the incandescent gas system is less expensive than deficient lighting with antiquated lamps and ordinary burners.

SUTHERLAND'S

PATENT

PREPAYMENT GAS-METERS

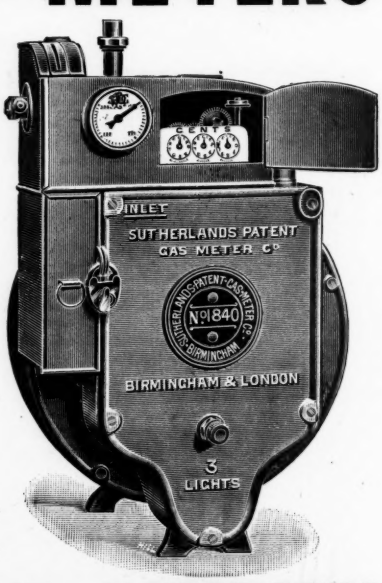
SPECIAL FEATURES:

Accuracy of Measurement.

Simplicity of Construction.

Excellency of Workmanship and Material.

EVERY METER GUARANTEED.



THE SUTHERLAND GAS-METER COMPANY

ESSEX WORKS, BIRMINGHAM.

Suggested Advance in Price at Manchester.—A recommendation is to be put before the Manchester City Council by the Gas Committee, that the price of gas be advanced from 2s. 3d. to 2s. 6d. per 1000 cubic feet to consumers within the city, and from 2s. 6d. to 2s. 9d. to consumers outside the city, from June 24 next. This will alter the Committee's estimates, enabling them to pay in relief of the rates £51,900 on the present annual rate of consumption, instead of £20,000 as had been proposed, and this without drawing from the reserve fund, which was to have supplied £10,000 towards the £20,000. The completion of the past year's accounts has proved that the trading was successful by about £10,000 beyond the estimate. The consumers outside the city will pay £8500 towards the amount raised by the proposed advance, if it is approved by the Council. It is only eighteen months since the price of gas was brought down to its present figure; and the advance recommended will put it back to a point at which it remained for many years. If the Council adopt the recommendation, the City rate can be reduced 3d.

Gas Consumers' Complaints at Birmingham.—During the past week or two, the correspondence column of the "Birmingham Post" has contained several complaints on the part of gas consumers, who state that, though they have been using the customary number of burners under ordinary conditions, their accounts for the past quarter show increases, which in some cases amount to as much as 40 per cent. Our contemporary has done a service to the Corporation Gas Department by informing its readers of the conditions under which their meters may be tested. In concluding the information, it is mentioned that an effort is made by the department to identify the writers of letters to newspapers, so that inquiry may be made. Such a case happened only a week or so ago; and here is the result: A correspondent wrote complaining of an increase of 80s. on the quarter's account; and an investigation took place. It was found that for the March quarter of 1899, the meter was read on Dec. 15, 1898, and on March 16, 1899, giving the consumption for 91 days. For the past quarter the readings were taken on Dec. 14, 1899, and on April 3; and the consumption recorded was, therefore, for 110 days. The explanation given for the longer period which was allowed to elapse this year is that the meter inspector was unable to gain admission to the premises on the usual day. The difference in the dates amounts to rather more than a 20 per cent. increase in the period during which consumption took place. As the correspondent does not mention the fact in his letter, he has evidently overlooked it; and, though it does not explain the whole of the increase, it shows the necessity for care when making comparisons. Another inquiry has been made as bearing on the complaint. The occupiers of the premises on either side of the firm were found to have reduced their consumption, in one case to the extent of 25 per cent., and in the other by 20 per cent., compared with the corresponding quarter of last year. In each case the consumption is smaller than that of the complaining firm; but it is obvious that anything affecting the gas supply so far as it is under the control of the Corporation would, in proportion, equally affect three consumers whose premises are side by side. The officials of the department have no way of singling out the middle one, and forcing up his figures.

Gas-Works in the Market.—The little gas-works at Sawston, Cambridgeshire (of which particulars have recently been advertised), were submitted for sale by auction by Mr. Alfred Richards last Tuesday. The bidding, however, did not reach the reserve fixed by the vendor; so that the works have not yet changed hands. We believe the reserve was somewhere between £500 and £600; and this is considered as very moderate, even having regard to the present outlook. A somewhat larger property—the Crawley Gas-Works—will come under Mr. Richards's hammer on June 12; and we learn that Sussex gas managers are evincing a lively interest in the fate of the concern, which has an output of between 5 and 6 million cubic feet.

The Price of Gas at Totnes.—In the course of their annual report, the Directors of the Totnes Gas Company refer to the increase of the price of gas which was the subject of much adverse comment in the town when it was announced. During the past year, gas has been supplied at the previous rate of 3s. 6d. per 1000 cubic feet; but the Directors say that, owing to the unprecedented rise in the price of gas coal (amounting to over 100 per cent. at the collieries, on the Company's last contract), they thought it necessary to raise the price to 4s. 6d. from Lady Day. Early in February they proposed to increase the price to 4s. from Christmas last; but, as strong opposition was shown by the consumers, the proposal was withdrawn, and the larger increase from Lady Day was substituted. The contract for public lighting, which has six months more to run, is now being worked at a loss. When the price of coal is reduced and other circumstances permit, the Directors hope to lower the price of gas to the original figure.

Sales of Shares.—At the Mart, Tokenhouse Yard, last Tuesday, Mr. Alfred Richards sold by auction 1000 £10 new ordinary shares in the Southend Water-Works Company, at prices varying between £11 5s. and £11 15s., or an average of £11 8s. 2d.; and 15 £10 additional ordinary shares at from £13 15s. to £15, or an average of £14 14s. 3d. On the same occasion, £3900 of ordinary "C" stock in the Ilford Gas Company was sold out of a new issue of £10,000, at from £110 to £112 per cent., or an average of £110 4s. 1d. About two months ago an issue of this stock (£7000) realized an average price of £125; but since then the investing public have become more fully alive to the coal question. At North Shields, on Monday last week, Mr. R. M. Tate sold stock of the South Shields Gas Company at the rate of £192 per £100 of stock, and stock of the Tynemouth Gas Company at £125 per cent. A few £10 "A" shares in the Deal and Walmer Gas Company have been disposed of at £21 15s. per share. At Dudley last Tuesday, £2700 of new ordinary stock in the local gas company realized by auction £152 to £153 per cent. At Gloucester on Friday, Mr. H. Knowles sold £5000 of the Gas Company's consolidated ordinary (new) 5 per cent. stock; and it produced prices ranging between £124 and £126. The total amount realized was £6249 15s. Through a printer's oversight, the name of the Tonbridge Gas Company was omitted from the sales of shares paragraph in last week's "Journal," in connection with the sale of £1500 "E" stock, which realized prices at the rate of £190 per £100 nominal. The dividend under the sliding-scale is 8½ per cent. per annum.

CARBURETTED WATER-GAS APPARATUS

Merrifield—Westcott—Pearson Patents.

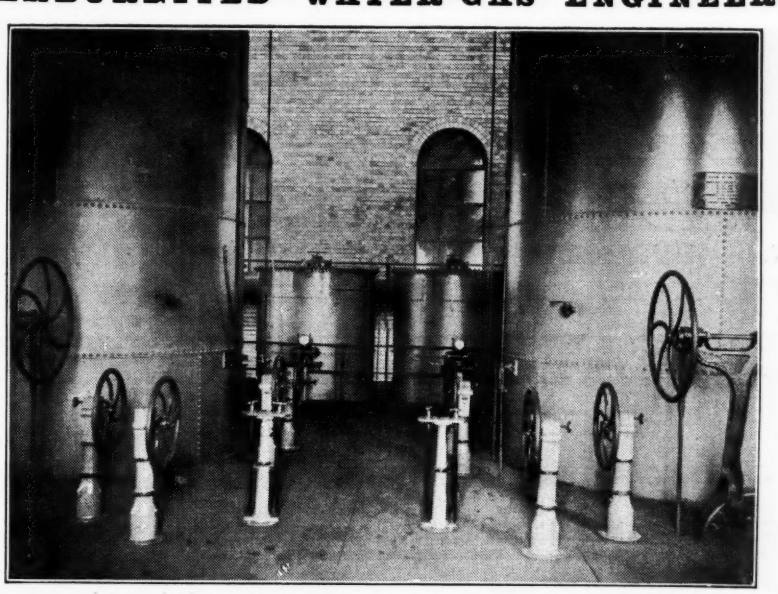
The Economical Gas Apparatus Construction Co., Ld.

London Offices: 19, ABINGDON STREET, WESTMINSTER, S.W.
American Offices: TORONTO. Telegraphic Address: "CARBURETED, LONDON."

W. H. PEARSON, Chairman.
W. H. PEARSON, Junr., Deputy-Chairman.
J. T. WESTCOTT, M.E., Manager.
L. L. MERRIFIELD, M.Inst.M.E., Engineer.

CARBURETTED WATER-GAS ENGINEERS.

THE M.-W.-P. PLANT is designed to use the Heaviest as well as the Lightest Grade of Oil.



RESULTS PROVE EFFICIENCY.

Working Floor of Generator House. One Quarter Section of Birmingham Plant, Windsor Street Station.
The Maximum Daily Capacity of the Birmingham Corporation's Plant, which was erected by this Company, is 10 MILLION CUBIC FEET.

Carburetted Water-Gas Plant for Oldham.—The Oldham Corporation have decided to manufacture carburetted water gas at their Hollinwood station, and have placed an order with Messrs. S. Cutler and Sons, of Millwall, for a plant to produce a million cubic feet per diem.

Liverpool Gas-Fittings Company, Limited.—The annual meeting of this Company was held last Wednesday, when a dividend of 5 per cent. per annum was declared. The Chairman (Mr. James Lister), in moving the adoption of the report, said that the Directors could have declared a higher dividend only that they felt bound to place the Company in the strongest possible position. The shareholders must not forget that the Company was originally started as a sort of "buffer" between the Liverpool Gas Company and the public, for any accidents that might happen in working for the public. When the Landing Stage was destroyed in 1874, the Gas Company had to pay over £100,000 for the fire; and, in order to protect themselves, the Directors inaugurated this Company, which had since, with one or two exceptions, worked with great success.

Bathurst (N.S.W.) Gas Supply.—On the occasion of the election of the new Mayor of Bathurst, a short time ago, Alderman Kenny, who had held the office for two years, gave the Borough Council some particulars in regard to the progress of the gas undertaking. He stated that in February, 1898, there was a debit balance of £2221; and the expenditure for the year was £4847. This brought the total up to £7068, against which they had receipts from gas, tar, coke, lighting, &c., amounting to £6561; leaving a debit balance of £506 due to the general fund. In the one year, therefore, they had reduced the debt from £2221 to the small sum of £506. Turning to the figures for the year 1899-1900, they started with the balance of £506, and the expenditure for the year was £4852; making a total of £5358. Against this there were receipts amounting to £6360, which left them with a credit balance of £1002. He remarked that, having started two years ago with a debit balance of £2221, the present was a state of affairs upon which they could congratulate themselves; and it appeared to him to be a complete and satisfactory answer to those who said the gas-works did not pay, and were carried out on an improper basis. He did not know from memory what was the exact cost of the works; but he thought it was something like £27,400. They now owed £12,000 on debentures and had £1000 to their credit; so that, if this was not a satisfactory state of affairs, especially when it was considered that they sold, he believed, the cheapest gas in Australia (3s. per 1000 cubic feet), he did not know what was. Within a few years they had a magnificent asset from which it would be possible to derive revenue which could be utilized for many purposes, and especially for beautifying the city. As a contrast to this pleasant story, we have to record that on the morning of the 21st of March Bathurst was visited by a violent storm which flooded the gas-works—the water rushing through them like a river, and being in some places 2 ft. 6 in. deep. Fortunately the Manager (Mr. G. Stone) was able to keep up the supply of gas, but at a reduced pressure. Regenerator firing is employed, and the brickwork of the furnaces sustained considerable damage; there being about 6 feet of water in them.

Stratford-on-Avon Gas Committee and the Rates.—The Gas Committee reported to the Stratford-on-Avon Town Council last Tuesday that, in consequence of the great increase in the price of coal, it was felt that for the current year the net receipts would only be sufficient to pay the interest on annuities and sinking fund; and consequently nothing would be available in reduction of the rates. Alderman Hawkes mentioned that about 5000 tons of coal were used during the year; and the increased cost had been estimated at 5s. per ton.

Water-Works Extensions Required at Harrogate.—Colonel W. R. Slacke, R.E., held an inquiry, on behalf of the Local Government Board, at Harrogate last Wednesday, into the application of the Corporation for sanction to a loan of £35,000 for purposes connected with the water-works. Alderman Fortune explained that the amount was needed for the purpose of putting in proper repair and covering in a disused reservoir which it was intended to use as a service reservoir. A new tank was also required to supply a population of about 600 on the high level, which could not be supplied by the present reservoirs. Three additional filter-beds and several extensions of mains were urgently necessary. There was no opposition to the proposal.

A New Gasholder for Maidstone.—The Maidstone Gas Company are increasing their storage by erecting a new gasholder adjacent to the works in St. Peter Street. It will be a two-lift holder, with a capacity of about 1¼ million cubic feet; and provision will be made for adding a third lift when necessity demands. The diameter of the holder will be 150 feet; and in height it will be 70 feet with two lifts, and 105 feet with three lifts. The present holders combined have a capacity of about 600,000 cubic feet; so that the new erection will be considerably larger than both. The tank is being constructed by Messrs. John Aird and Sons; while the holder will be erected by Messrs. Clayton, Son, and Co., Limited. The tank will probably be completed by the end of the present year; but the holder and the work in connection therewith will not be entirely finished till the autumn of 1901.

Ipswich Corporation Water Department.—The Manager of the Ipswich Corporation Water Department (Mr. Hamlet Roberts), in his annual report, as submitted to a meeting of the Council on Wednesday, stated that the total quantity of water pumped into the reservoirs during the past year was 345,391,946 gallons, which was an increase of 59,377,199 gallons over the previous year. The large increase was to be attributed to the additional number of water-closets now supplied, and to the increased waste from defective fittings. Mr. Roberts mentioned that, if his calculation as to probable weekly increase proved correct, in 1904 the requirements of the borough would exceed the present yield of the wells by about 500,000 gallons. Notwithstanding the increase of nearly 60 million gallons pumped, the cost per million gallons had shown a decrease from £1 15s. 2d. to £1 13s. 10¾d. Mr. W. O. White, in presenting the report, said that on last year's working, after payment of all expenses, £1119 had been saved; and the balance on revenue account from the taking over of the works, amounted to £4919. They had already given £2000 in aid of the rates, though the works had not been carried on in a niggardly fashion. The report was adopted.

C. & W. WALKER, LTD.,

Midland Iron-Works, Donnington, nr. Newport, Shropshire.

110, CANNON STREET, LONDON, E.C.

Telegraphic Addresses: "FORTRESS, DONNINGTON, SALOP." "FORTRESS, LONDON."
Codes used A.B.C. and "A1."
Telephone No. 12, WELLINGTON, SALOP.

MAKERS OF GADD & MASON'S SPIRAL-GUIDED

GASHOLDERS.

GASHOLDERS WITH OR WITHOUT STEEL STANDARDS AND TANKS.

PURIFIERS. PURIFYING-MACHINES FOR AMMONIA. SCRUBBERS.
TAR-EXTRACTORS. RETORT MOUTHPIECES OF ANY SHAPE.

WECK'S PATENT CENTRE-VALVES.

CONDENSERS.

SIEVES. CRIPPS'S HYDRAULIC MAIN AND GRID VALVES. TAR-BURNERS.

TYSOE'S SELF-SEALING MOUTHPIECES.

Tar-Distilling Plants. Valves. Claus' Sulphur-Recovery Plants.

SULPHATE OF AMMONIA PLANTS.

The Purchase of the Gainsborough Gas-Works.—Immediately after the public meeting authorizing the acquisition of the Gainsborough gas undertaking by the town, the District Council appointed a Committee to enter into negotiations with the Company. In February the Company made an offer to dispose of the works for £101,811, exclusive of compensation and stock. They have now offered to sell the undertaking for £82,500, which will include debentures and compensation to the Secretary. At the meeting of the Council yesterday week, a recommendation of the Special Committee was adopted, by which the offer was accepted on certain minor conditions. The amount is some £20,000 more than was estimated at the town's meeting. There is now little prospect of arbitration proceedings.

The Profits of the Heywood Gas Department.—Reporting on the past year's working of the Gas Department at the meeting of the Heywood Town Council last Thursday, Mr. Sutcliffe Firth said the profits amounted to £1767; and the Committee had decided to hand over £1000 in relief of the rates, and to carry the balance of £767 to the credit of the reserve fund. He thought the result was very satisfactory. The amount transferred to the relief of the rates was not so large as last year; but it must be remembered that the price of coal had been higher, and in the coming year would be still greater. The Committee did not wish to raise the price of gas if it could be avoided. For the past year the consumption had been very satisfactory. The total quantity manufactured was 125,724,000 cubic feet, or an increase of 7,079,000 cubic feet; the total amount of coal and cannel used being 12,451 tons. The report was adopted.

Retrospective Increases in Price.—The Bognor Gas Company have had to fall into line with many other similar bodies and raise their price, from the cause which has operated in all the other instances of an advance—the high cost of coal. The Urban District Council do not like this, and some very hard things were said against the Company at the meeting of the former body on the 4th inst. The Chairman (Mr. H. Lovett), who is a Director, pointed out that the Company would not have altered the price had it not been for the increased cost of coal; the contract they were entering into being just about 30s. per ton. Moreover, other companies had had to do likewise. The Chairman's attention was called to the fact that the Company proposed to make the increase retrospective; and he replied that the Directors thought it was better to go back a month or two, and make the increase 6d., than to go in for a rise of 9d. or 1s. Some reference having been made to the Company's dividends, the Chairman reminded the Council that, owing to the rise of 6d., the dividend would have to be reduced to 8½ per cent. The question of the power of the Company to make the increase retrospective was referred to the Clerk, who stated that, before he sent in his report, he would peruse the Company's Order, so as to see whether consumers could be legally called upon, by a notice dated the 1st of May, to pay extra for gas supplied from the 31st of March, without being informed in advance that the price was to be raised. A member expressed the opinion that this would be a "ticklish point." In the result, the whole question was left with the Lighting Committee for further consideration.

Mid-Sussex Water Supply.—In connection with the water undertaking of the Cuckfield Rural District Council, a duplicate set of pumping machinery was started last Wednesday, and the foundation-stone of a new water-tower laid. The machinery consists of a new 20-horse power engine, and a set of three-throw 10-inch pumps.

The Geltsdale Water-Works for Carlisle.—At the meeting of the Carlisle Town Council last Tuesday, the Geltsdale Water Committee reported that Mr. E. M. Eaton had approved the plans submitted by Mr. C. B. Newton of the water-works between the proposed reservoir at Castle Carrock, Geltsdale, and the service reservior at Carlisle. Mr. Corbett, Chairman of the Committee, in moving the confirmation of the minutes, said the plans had been completed, with the exception of those of the reservoir. The work of examining the foundations and strata and doing other things necessary for the large reservoir at Castle Carrock was proceeding satisfactorily. The trial holes sunk to ascertain the nature of the foundation had so far given satisfactory results. The minutes were confirmed.

Incandescent Street-Lighting at Plymouth.—The Electricity and Street Lighting Committee of the Plymouth Corporation have accepted a tender of the Welsbach Company for the supply of burners, mantles, lanterns, &c., for the application of incandescent lighting to those of the public lamps in the town to which the system has not hitherto been applied. The Company's tender for burners, mantles, stopcocks, &c., was £1160 12s. 6d., and was the lowest of four tenders received. For the supply of lanterns and frogs, there were ten tenders; and the one accepted amounts to £1635. While incandescent lighting is being extended in Plymouth, it is also to be applied in the neighbouring district of East Stonehouse; so that, with the exception of those lit with electric arc lamps, all the streets in the district supplied by the Plymouth and Stonehouse Gas Company will be lighted on this system. In East Stonehouse, the conversion of the lamps and the maintenance of the mantles will be undertaken by the Gas Company, who have entered into a new contract with the District Council.

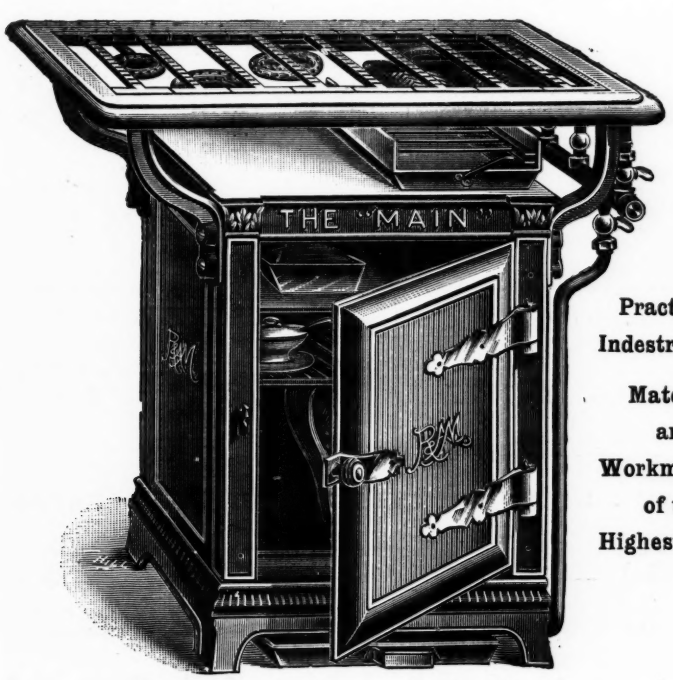
The "Builder" Condemns the London County Council Testing Bill.—In a short paragraph dealing with the proceedings before the Select Committee of the House of Commons on the London County Council Gas-Testing Bill, the "Builder" last week pointed out that the evidence against the Bill consisted mainly in showing that the photometrical value ascribed to gas depends entirely upon the conditions under which it is tested, and that therefore it should in fairness only be examined under reasonable conditions, such as those hitherto recognized by the Gas Referees; also, in pointing out that by compelling the Gas Companies to send out richer gas, they would not benefit the consumer, for the Gas Companies would have to raise the price of gas to cover the extra cost of enrichment, while the consumer would not be able to detect any appreciable difference between the more highly enriched gas and that which he now receives. In a note to the paragraph, our contemporary says: "London gas consumers will learn with satisfaction that the Select Committee have thrown out the portion of the Bill which deals with the portable photometer."

R. & A. MAIN, Ltd.

214, ST. JOHN STREET, CLERKENWELL GREEN, LONDON, E.C.

EDMONTON: GOTHIC WORKS. | BRISTOL: 28, BATH STREET. | MANCHESTER: 37, BLACKFRIARS STREET. | GLASGOW: ARGYLE WORKS, KINNING PARK. | FALKIRK: GOTHIC IRON-WORKS.

The "Main" Gas-Cookers.

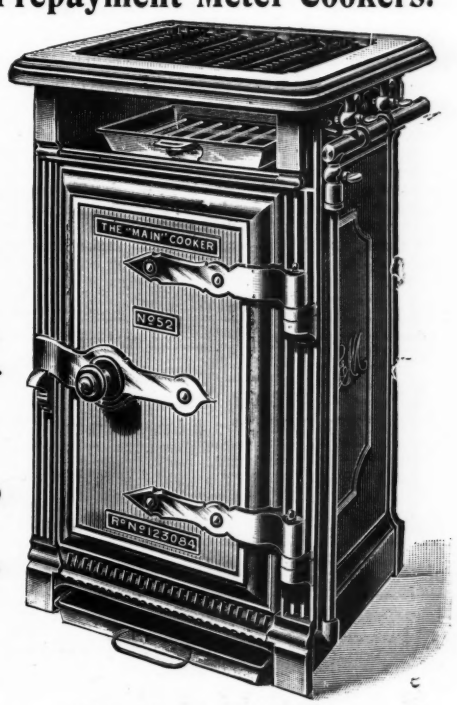


Prices from £4 12s. 6d. to £13 10s.

Practically Indestructible.

Materials and Workmanship of the Highest Class.

Prepayment Meter Cookers.



Prices from 25s. to 80s.

The Bolton Corporation Water-Works undertaking shows a profit for the past year of £16,806, of which £16,000 is to go in aid of the rates.

The Cape Town District Water-Works Company and the Municipalities.—The Arbitrators appointed to decide the amount to be paid by the Municipal Councils of Claremont and Woodstock for the undertaking of the Cape Town District Water-Works Company have published their award. There was a wide difference between the price asked by the Company and that offered by the Corporations. The former claimed £519,750; and the sum offered was £150,000. The latter is the equivalent of the Company's capital account, which is made up of 16,000 shares at £5 each, £80,000; and money borrowed, £70,000. The amount awarded was £219,350. Payment is to be considered due as from Jan 1, 1899. The date of the taking over of the concern is to be mutually agreed upon. Interest at the rate of 4 per cent. on the amount of the award is to be paid by the Municipalities until they complete the purchase; and, on the other hand, the Company are to account for the net earnings from Jan. 1, 1899. The Municipal Councils will pay the Company the value of the stores shown in the books on Jan. 1, 1899, together with interest on this sum at 4 per cent.; and they will take over all existing servitudes and contracts of the Company. The parties will pay their own costs, and half the costs of the arbitration.

The Honley District Council and the Gas-Works.—At the last ordinary meeting of the Honley District Council, the question of the purchase of the undertaking of the Honley Gas Company was considered in private. Mr. E. A. Harman, of Huddersfield, had been consulted on the matter; and he strongly recommended the Council to acquire the works. The price asked (£18,500) was, he said, a reasonable one; and the plant and buildings were in a substantial condition and would not require extension for a considerable time. It would be a very profitable undertaking. The Clerk (Mr. J. Sykes) remarked that he had communicated with the Local Government Board, asking for their sanction to the purchase; and in their reply they pointed out that the Company, by their Provisional Order, were under obligation to supply a certain district outside the area of the Council, and they were not prepared to sanction the scheme under these circumstances, according to section 162 of the Public Works Loans Act. The Clerk added that he thought that, having failed to secure the sanction of the Local Government Board under the existing conditions, it would be necessary to obtain an Act of Parliament, which would involve an outlay of about £500. Mr. Harman (who was present) was asked if he would still recommend the purchase of the works; and he replied that he thought the difficulty with the Local Government Board might be reduced to a minimum. Some authorities supplied outside districts in bulk, by meter; and in this way special parliamentary facilities had been avoided. But even if the Council had to apply for an Act of Parliament, the acquisition of the undertaking would, he thought, be worth the expense and trouble. After some discussion, it was resolved to endeavour to obtain the sanction of the Local Government Board to the purchase, without the necessity for obtaining a separate Act of Parliament.

Water under Cost Price to Large Consumers at Bradford.—This question was again raised at the meeting of the Bradford City Council last Tuesday, on the presentation, by Alderman Holdsworth, of the minutes of the Water Committee. These showed that the Committee had disapproved of a resolution of the Contracts and Works Sub-Committee, to the effect that charges for water for manufacturing purposes through meters be continued at the same rate as at present up to 400,000 gallons, but above that quantity the rate be 8d. per 1000 gallons. Mr. Hartley, who was told that he would have another opportunity of expressing his opinion on the question, preferred to do so at once. He asserted that there was one large firm who entailed a loss of £800 a year on the city for the water supplied to them; whereas the total amount which the firm paid in rates was only £900 a year. Two other firms who paid jointly £1100 in rates obtained their water £2500 under cost price. Thus they were carrying on business rate free, and were receiving a subsidy of £1400 per annum from the city. While the Water Committee were paying these subsidies to a few rich ratepayers, they were unable to make their accounts balance, and had occasionally to make a heavy draft on the rates and the gas profits in order to pay their way. He believed that a public service should be for the public good; but here was a public service being used for furthering private interests against the public good. Mr. Thomas Whiteley explained that the matter had been put back with a view to obtaining further information. It must be remembered that the large consumers paid 9d. per 1000 gallons for the first 400,000 gallons, which was more than the cost price; so that the quantity which had to be used before any firm obtained water under cost price must be very large. Something would be done by the Committee; but it was undesirable to make Bradford water dear just when they were on the point of receiving an inflow of abundant water. It should be their policy rather to encourage people to use the water.

Bridgnorth Gas Supply and Electric Lighting.—The consumption of gas has increased so rapidly at Bridgnorth that a considerable sum will have to be expended on the gas-works if they are to be in a position to meet requirements. At the meeting of the Council last Tuesday, Alderman Whitefoot stated that the consumption when the Corporation took over the works was 15 million cubic feet per annum; and now it was 26 millions. He asked the Council whether the time had not arrived when they should undertake the supply of electricity. Other speakers were favourable to the suggestion; and, although no formal vote was taken, the opinion of the members appeared to be unanimous on the point.

Evesham Corporation Gas Supply.—At last Wednesday's meeting of the Evesham Town Council, it was resolved to authorize the Gas Committee to make inquiries and report on the question of electric lighting for the borough. The Chairman of the Committee said that the advanced price of coal would mean an additional cost of about 8d. per 1000 cubic feet of gas made; and within the next few years it would be necessary to spend a considerable sum on the gas-works to provide for the continuous increase of business. The borrowing powers of the Gas Committee under their Provisional Order were within £1000 or £1100 of being exhausted; and for further expenditure it would be necessary to obtain another Provisional Order. They thought it wise therefore to ascertain whether it would not be possible to obtain another form of lighting to run side by side with the gas undertaking.

Wallasey Water Supply.—At the last monthly meeting of the Wallasey District Council, the Engineer submitted proposals for increasing, by means of the air lift or compressed air process, the yield of water from the No. 1 bore at Poulton from 150,000 to 700,000 gallons per day, and so for the present to dispense with No. 2 well, from which from 400,000 to 500,000 gallons of hard water are now obtained daily. The Committee instructed the Engineer to visit places where the process is in operation, and report. They recommended the Council to apply for power to borrow £18,500 for the construction of a second reservoir at Gorse Hill, New Brighton, to contain about 4 million gallons (the existing storage accommodation being only adequate for one day's supply), £3750 for a new tower and tank for 7000 gallons at Gorse Hill to improve the pressure, and three sums amounting to £1475 for new and enlarged mains, &c. The recommendation was approved.

North Warwickshire Water Supply.—The Sanitary Committee of the Warwickshire County Council have reported that, under the powers delegated to them by the Council, and acting in conjunction with the agents representing the Meriden, Solihull, and Rugby Rural District Councils, they negotiated with the promoters of the North Warwickshire Water Bill, and obtained modifications of the clauses to provide that the exclusive powers should expire in three instead of five years; that the wells should be lined for 40 feet at least from the surface, so as to exclude the percolation of surface water into the wells; that the power to take and divert springs, streams, &c., should be curtailed; that the power to take additional land by agreement should be omitted; that the power to supply water in bulk beyond the Company's limits of supply should be omitted; that a maximum rate for the supply of water for public purposes should be fixed; and that, after the expiration of a period of 25 years from the passing of the Act, the District Councils should have power to purchase. Thereupon the petition on behalf of the Council was withdrawn. The Bill was subsequently opposed by the Meriden and Solihull District Councils, when the period after which the District Councils should have power to purchase was reduced from 25 to 10 years.

The Directors of the High Wycombe Gas Company have unanimously resolved to increase the salary of their Engineer and Secretary, Mr. J. Fred. Wicks, to the extent of £100, "in recognition of his ability and additional duties entailed by the new departures previously reported and inaugurated by him."

The Thornaby Corporation will shortly have a report presented to them in regard to the position they would be in should they decide to erect gas-works for the purpose of providing for their own public lighting, instead of taking a supply from Stockton. A litttle delay in the presentation of the report has been caused by the consultation of experts.

The profit-sharing scheme of Messrs. Richmond and Co., Limited, has undergone a development. Hitherto the bonuses have been handed to the men half in cash; but in future they are to be distributed entirely in shares, in order to give every man and boy a greater interest in his work, and to enable them to save. The shares are to be distributed at a rate representing half as much per cent. on the wages as the dividend paid to the ordinary shareholders represents on their capital. As an example, last year the ordinary shareholders were paid a dividend of 10 per cent.; and each employee therefore receives shares equal to 5 per cent. of his wages. If less than 6 per cent. is divided among the shareholders, there is to be no bonus. The first distribution of "scrip" took place last week.

GAS PURIFICATION AND CHEMICAL COMPANY, LIMITED.

OXIDE OF IRON.

O'NEILL'S Oxide has a larger annual sale than all other Oxides combined. Purity and uniformity of quality guaranteed.

JOHN WM. O'NEILL, Managing Director,
160, 161, & 162, PALMERSTON BUILDINGS,
OLD BROAD STREET,
LONDON, E.C.

ANDREW STEPHENSON, AGENT. All communications re Oxide to the Company as above.

WINKELMANN'S
"VOLCANIC" FIRE CEMENT.
Resists 4500° Fahr. Best for use in GAS-WORKS.
ANDREW STEPHENSON,
182, Palmerston Buildings,
Old Broad Street,
"Volcanism, London." London, E.C.

J. & J. BRADDOCK (Branch of Meters Limited), Globe Meter Works, OLDHAM; and 45 & 47, Westminster Bridge Road, LONDON, S.E.
First-Class Award, Melbourne Exhibition, 1889, for WET AND DRY GAS-METERS, STATION METERS, AND GOVERNORS, PRESSURE-GAUGES, STREET LAMPS AND PILLARS, &c.
Telegraphic Addresses:
"Braddock, Oldham." "Metrique, London."

SULPHURIC ACID.

JOHN NICHOLSON & SONS, Limited, Chemical Works, Leeds, specially produce this ACID from SULPHUR, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

GAS TAR wanted.
BROTHERTON AND CO., Tar Distillers.
Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

BENZOL, specially made for the Enrichment of Gas.
ELLISON AND MITCHELL, LIMITED, Kilnhurst, near ROTHERHAM.

GAS PURIFICATION.

OXIDE OF IRON BOG ORE.

BALE & CO.'S Oxide of uniform quality.
SPECIAL FIRE CEMENT, OXIDE PAINTS, OILS, SULPHURIC ACID, &c.
120 and 121, NEWGATE STREET, LONDON, E.C.
Telegrams: "BOGORE, LONDON."

SADLER & CO., Ltd., Middlesbrough
Tar Distillers and Tar Colour Manufacturers.
BENZOL specially prepared for Gas Enrichment free from Sulphur. Pure Hydrated OXIDE OF IRON for Purifying Gas either for Sale or Lent on Hire. Always Buyers of GAS TAR and AMMONIACAL LIQUOR.

SULPHATE OF AMMONIA SATURATORS.

JOSEPH TAYLOR & CO., Chemical Plumbers, &c., and Makers of every description of Solid Plate Lead and Timber Cased Saturators, &c.,
CENTRAL PLUMBING WORKS, TOWN HALL SQUARE, BOLTON. Special attention to Repairs.
Before placing Orders, please write for Estimate.
Telegraphic Address: "SATURATORS, BOLTON."

NOTICE TO ADVERTISERS.—COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office *not later* than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or Stoppages of, PERMANENT ADVERTISEMENTS should be received not later than the FIRST POST on SATURDAY.

PATENTS FOR INVENTIONS.
Messrs. J. C. CHAPMAN & CO., Chartered Patent Agents, ADVISE ON ALL MATTERS CONNECTED WITH ABOVE.
Information and Handbook on application.
70, CHANCERY LANE, LONDON, W.C.

BROTHERTON & CO.
Offices: Commercial Buildings, LEEDS.
Correspondence invited.

HYDRATED OXIDE OF IRON.
PREPARED from Pure Iron.
Twice as Rich as Bog Ore.
Gives no Back Pressure.
The Cheapest in the Market.
Can be Lent on Hire.
Can be Exchanged for Spent Oxide.
READ HOLLIDAY AND SONS, LTD., HUDDERSFIELD.

AMMONIACAL LIQUOR wanted.
BROTHERTON AND CO., Ammonia Distillers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

TO GAS AND WATER OFFICIALS.
HIGH-CLASS Cycles at reasonable and low Prices. Guaranteed for Twelve Months. Sent on approval. For Cash or Gradual Payment System. Send for Catalogue, Post Free.
MELROSE CYCLE COMPANY, COVENTRY.

NEW GAS PLANT CEMENT.
JOHN E. WILLIAMS AND CO.,
VICTORIA PAINT WORKS,
MANCHESTER.
For all Joints in connection with Oil-Gas Plant and Sulphate Plant.
For all Gas Joints.
For all Tar Joints.
For all Ammonia Joints.

ENRICH your Gas with cheap Benzol.
Specially prepared, free from sulphur. At to-day's Price of Benzol, ILLUMINATING POWER costs less than ONE-THIRD OF A PENNY PER CANDLE.
Apply to SADLER AND CO., MIDDLESBROUGH.

PRACTICAL RETORT SETTERS.
GEORGE NUTTALL & CO., 32, Have-lock Road, Saltley, Birmingham.
Regenerator or other Furnaces erected to Engineers' own Designs. Best Work Guaranteed. Please write for Estimates.

SULPHURIC ACID for Sale.
BROTHERTON AND CO., Chemical Manufacturers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

PORTER & CO., Gowts Bridge Works,
LINCOLN, Engineers, Ironfounders, and Contractors for the erection of Gas-Works for Towns, Villages, Mansions, Manufactories, Collieries, and Isolated Buildings at home and abroad. Manufacturers of Retorts and Fittings, Condensers, Scrubbers, Purifiers, Valves, &c.; also of Girders, Wrought and Cast Iron Tanks, Iron Roofs, &c.
Telegraphic Address: "PORTER, LINCOLN."
[For Illustrated Advertisement, See May 8, p. 1178.

CANNEL, COAL, ETC.
JOHN ROMANS & SON, EDINBURGH,
Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS and WATER WORKS.
Prices, &c., will be forwarded on application
No. 30, ST. ANDREW SQUARE, EDINBURGH, } SCOTLAND.
NEWTON GRANGE, NEWBATTLE, DALKEITH, }

No. 3471.
THE Applicants for the post advertised in the "JOURNAL OF GAS LIGHTING" of the 10th of April last, under the above number, are informed that the APPOINTMENT HAS NOW BEEN MADE.

TO GAS COMPANIES.
ADVERTISER desires to obtain employ-ment in connection with the Fittings and Prepayment departments of a Gas Company. Has had 19 Years' Experience with a first-class London Firm. Can give excellent References.
Address No. 3491, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, good Retort Setters.
Apply to R. DEMPSTER and SONS, LIMITED, Elland, YORKS.

WANTED, a level-headed and practical Man to LAY OUT new Foundry and SUPERINTEND and take charge of CASTINGS for Gas Cooking-Stoves on up-to-date and economical System. Good and permanent position for suitable person.
Apply, by letter, to No. 3492, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

TO GAS MANAGERS.
WANTED, a thoroughly qualified MANAGER for Gas-Works, within 25 miles of London. Make about 45 Million Cubic feet per annum.
Apply, by letter, before the 25th inst., stating Age, Salary, and full Record of Experience, to No. 3493, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

DRAUGHTSMAN Wanted, accustomed to Structural Ironwork and General Gas-Works Plant.
Apply to JONAS DRAKE AND SON, Engineers, Ovenden, HALIFAX.

TEMPORARY ASSISTANCE.
WANTED, immediately (on account of sick leave), an experienced RENTAL and GENERAL GAS OFFICE CLERK.
Address N. H. HUMPHRYS, Gas-Works, SALISBURY.

WANTED, Two first-class Retort SETTERS used to Regenerator Settings. Good Wages to Competent Men.
Apply, by letter, to No. 3497, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

AGENTS wanted, already calling on Gas-Works, for the sale of Oxide of Iron. Good Terms.
Full Particulars, by letter, stating District worked, to No. 3494, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a thoroughly efficient Man as RETORT-HOUSE FOREMAN. One accustomed to Gaseous Firing preferred.
Apply, stating Age, Experience, and Wages required, to No. 3490, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a young married Man as GAS-FITTER, MAIN and SERVICE LAYER, and to have charge of all Outdoor Work, Lamps, &c.
State Age and Wages, with *copies* of three Employers' Testimonials.
Apply, by letter, to No. 3495, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, one or two additional REPRESENTATIVES calling on Gas Companies in Districts where Evenson's (Coal and Cannel) are not represented. Must have had good experience, and be well known to Gas Managers.
Replies, marked "Private," to be addressed to the EVESON COAL AND COKE COMPANY, LIMITED, BIRMINGHAM.

HIGH WYCOMBE GASLIGHT AND COKE COMPANY, LIMITED.
WANTED, by the above Company, a FITTER accustomed to Iron and Compowork. Wages £1 8s. per week (54 hours).
Applications and Testimonials to the undersigned.
J. FRED. WICKS, C.E.,
Engineer and Secretary.

CLERK of Works required to superin-tend construction of a Brick in Cement Gasholder Tank, about 30 miles from London. Must have had similar experience, and be prepared to keep full Working Hours. Remuneration, £2 10s. to £3 per week, according to experience.
Apply, by letter only, with *copies* of two recent Testimonials (which cannot be returned), to No. 3498, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, for a Gas-Works in the Mid-lands making 50 millions, a WORKING FOREMAN. Must understand Regenerative Furnaces, the manufacture of Sulphate of Ammonia, and capable of taking charge of the Works in the absence of the Manager. To an active Young Man desirous of improving his position, the above offers a good opportunity. A total Abstainer preferred. Wages to commence at 35s. per week.
Apply, by letter, stating Age and Experience, and enclosing recent Testimonial, to No. 3496, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

BOROUGH OF SMETHWICK.
(GAS DEPARTMENT.)
THE Corporation of Smethwick require the services of a competent and experienced man as MANAGER of the Gas-Works.
Salary £350 per annum.
Applications, stating Age, Training, and Experience, and accompanied by not more than three Testimonials (*copies*), endorsed "Manager," addressed to the Chairman of the Gas Committee, to be sent in not later than the 17th of May inst.
By order,
W. J. STURGES,
Secretary.
Gas Offices, Town Hall, Smethwick.

MERTHYR TYDFIL GAS COMPANY.
RENTAL CLERK.
WANTED, a Young Man as Rental CLERK. Must be experienced in the Accounts and General Routine Work of a Gas Office.
Applications, in own Writing, stating Age, Experience, and Particulars, of last employment, and enclosing *copies only* of two recent Testimonials, to be endorsed, "Rental Clerk," and addressed to the undersigned not later than Saturday, the 26th inst.
Salary £78 per annum.
JOHN L. COCKER,
General Manager and Secretary.
Gas Offices, Gas-Works, Merthyr Tydfil, Glamorganshire, May 2, 1900.

WANTED, 200 Retort Mouthpieces, with Self-Sealing Lids, 22 in. by 15 in. oval, c.i.f. Hamburg.
AUG. KLÖNNE, Dortmund, GERMANY.

ENGINES and Exhausters combined
"Waller," to pass 30,000 cubic feet per hour.
DITTO to pass 7000 feet per hour, overhauled and complete. Cheap to clear. Also BOILERS.
J. FIRTH BLAKELEY AND CO., Thornhill, DEWSBURY.

FOR SALE—Two Lancashire Boilers, each 6 ft. diameter by 20 ft. long, with Mountings. Been in use only a short time. Made by the Yorkshire Engine Company, Limited, Sheffield.
Apply to NEWTON, CHAMBERS, & CO., LIMITED, Thorncliffe Iron-Works, near SHEFFIELD, where the Boilers may be seen.

GAS PLANT for Sale—I can always offer NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also a few COMPLETE WORKS. Compare Prices and Particulars before ordering elsewhere.
J. F. BLAKELEY, Gas Engineer, Thornhill, DEWSBURY.

CONDENSERS, Washer-Scrubbers,
"Cutler" patent CONDENSERS (14) 6 in. to 12 in.
PIPE CONDENSERS, Patent WASHERS by "Livesey," "Holmes," and "Cockey," EXHAUSTERS up to 60,000 Cubic Feet per hour. ENGINES, BOILERS, &c. Several TOWER SCRUBBERS, PURIFIERS, METERS, GOVERNORS, PUMPS, TANKS, VALVES, &c.
J. FIRTH BLAKELEY AND CO., Gas Engineers, DEWSBURY.

THE Bromsgrove Gaslight and Coke Company, owing to Extensions, have FOR DISPOSAL—
One WASHER-SCRUBBER (by Laycock and Clapham), with 10-inch Connections, made to pass 100,000 cubic feet per diem.
One TOWER-SCRUBBER, 3 feet diameter and 20 feet high, with 10-inch Connections.
The above can be seen at work, and any other Information obtained, on application to the MANAGER.

THE Calne Gas and Coke Company, Limited, have FOR SALE the following APPARATUS. Offers to be sent to the Secretary at Church Street, Calne, Wilts.
All necessary CONNECTIONS for three Purifiers by Cockey and Sons, comprising:—
One Lift for 8-feet Purifier,
Four 6-inch Rack and Pinion Valves,
One 6-inch Centre-Valve with Column,
One 6-inch Bye-Pass Valve with Column,
Nineteen 6-inch Bends and Springs,
One 6-inch T-Piece.
Thirteen Caps and Clips.

THE Dawley Gas Company are prepared to receive TENDERS for the supply of a SINGLE-LIFT GASHOLDER, to replace one now in. Size required 40 ft. 3 in. diameter by 12 ft. deep. Present Columns and Pulleys only to remain.
Tenders to be sent in on or before May 21.
Any further Particulars may be had from the SECRETARY.

FOR SALE.
BY ORDER OF THE DIRECTORS OF THE SUTTON (SURREY) GAS COMPANY.
A CONDENSER, by Morris and Cutler, 15 ft. by 5 ft. by 6 ft., with 12-inch Valves, Connections, and Bye-Pass complete, for 500,000 cubic feet per day.
A WASHER, Livesey, 5 ft. 6 in. by 4 ft. by 2 ft. 9 in. deep, with 12-inch Connections, Valves, and Bye-Pass complete, for 500,000 cubic feet per day. Also
A SCRUBBER, "Standard" Washer Scrubber by Kirkham, Hulett, and Chandler, 12 ft. by 5 ft. 9 in. by 6 ft high, with 12 inch Connections and Valve, for 500,000 cubic feet per day.
The above Plant is in perfect condition, and can be seen working. It is about to be removed to be replaced by Plant of greater capacity.
For further Particulars, apply to GEO. MEAD ROBINS, Secretary and Engineer, Sutton, SURREY.

RUSHDEN AND HIGHAM FERRERS DISTRICT GAS COMPANY.
THE Directors of the above Company invite TENDERS for the supply of 8000 Tons of good GAS COAL or NUTS during the Twelve Months ending the 30th of June, 1901.
The Coal to be delivered on the Gas Company's Sidings Midland Railway.
Sealed Tenders, endorsed "Tender for Coal," and addressed to the Secretary, Gas Company's Offices, Rushden, to be sent in on or before Monday, the 28th of May inst.
Full Particulars may be obtained from the undersigned.
THOMAS WATSON,
Engineer and Manager.
Gas-Works, Rushden,
May 12, 1900.

BOROUGH OF DUKINFIELD.

(Gas Department.)

TENDERS for Tar produced at the Dukinfield Gas-Works in the Year commencing the 1st of July are required by the 26th inst.

Quantity about 500 Tons, delivered free on boat.

Tenders to be sealed and endorsed "Tar."

Harrison Veevers, C.E.,
Engineer and Secretary.

Dukinfield,
May 12, 1900.

CITY OF CARLISLE.

THE Carlisle Gas Committee are pre- pared to receive TENDERS for the supply of COAL and CANNEL required at their Works during One Year from the 1st of July next.

Tenders to be delivered to the undersigned not later than June 2, 1900.

Forms of Tender and other Particulars on application.

C. B. Newton,
Engineer and General Manager.

Gas-Works, Carlisle,
May 12, 1900.

CITY OF CARLISLE.

THE Carlisle Gas Committee are pre- pared to receive TENDERS for the purchase of the surplus TAR produced at their Works for a period of One Year from the 1st of July next.

Tenders to be delivered to the undersigned not later than June 2, 1900.

Further Particulars can be obtained on application.

C. B. Newton,
Engineer and General Manager.

Gas-Works, Carlisle,
May 12, 1900.

TO COAL MERCHANTS, SHIP OWNERS, AND OTHERS.

THE Directors of the Torquay Gas Com- pany are prepared to receive TENDERS for the supply of about 10,000 Tons (or such other quantity as may be agreed on) of best approved GAS COALS.

Tenders to state the price of the Coals, and the freight to Dartmouth or Torquay, separately and together, and also for delivery into the Company's Works, adjoining the Great Western Railway, free of all charges.

Further Particulars and Forms of Tender to be obtained from Mr. Beynon, the Manager of the Company, Hollacombe, Paignton; and Tenders to be sent to the undersigned before the 23rd of May inst.

John Kitson,
Secretary.

Torquay, May 7, 1900.

SOWERBY BRIDGE URBAN DISTRICT COUNCIL.

TENDERS FOR COAL AND CANNEL.

THE Gas Committee are desirous of receiving TENDERS for 14,900 Tons of COAL or less, and 1200 Tons of CANNEL, as may be required, for the Gas-Works at Sowerby Bridge and Luddenden Foot for the Year ending May 31, 1901.

Specifications and Forms of Tender can be obtained by applying to Mr. John Marsland, Engineer and Manager, Gas-Works, Sowerby Bridge.

The Gas Committee do not bind themselves to accept the lowest or any Tender.

Tenders must be sent in not later than Saturday, the 26th of May, 1900, endorsed "Tender for Coal," or "Cannel," respectively, and addressed to

Godfrey Rhodes and Evans,
Clerks to the Council.

Commercial Bank Chambers,
Halifax, May 8, 1900.

RHONDDA URBAN DISTRICT COUNCIL.

(Gas and Water Department.)

TENDERS FOR GAS PLANT, &c.

THE Gas and Water Committee of the above Council invite TENDERS for the following:—

Contract No. 7—Installation of Mr. W. R. CHESTER'S REGENERATOR FURNACES, with all the necessary Ironwork at the Porth Gas-Works.

Contract No. 8—One STEEL CORNISH BOILER, 16 ft. 6 in. long, and 4 ft. 6 in. diameter, with all necessary Fittings, &c., at the Porth Gas-Works.

Contract No. 9—STATION METER, in Rectangular Case, to pass 20,000 cubic feet of Gas per hour at the Ystrad Gas-Works.

Contract No. 10—One 20-Ton WAGGON WEIGHING-MACHINE at the Porth Gas-Works.

Contract No. 11—One TWO-LIFT GASHOLDER, 40 feet high, and of an average diameter of 108 feet; also a STEEL GASHOLDER TANK for same, 20 feet deep by 112 feet diameter, at Tonypandy.

Contract No. 12—LAYING and JOINTINGS about 3200 yards of 4-inch and 3-inch GAS-MAINS at Tonypandy, Treorky, and Blaencwm.

The Drawings and Specifications may be seen, and Forms of Tender obtained, upon application to Mr. Octavius Thomas, Engineer and Manager, Gas and Water Offices, Pentre, R.S.O., Glam.

Contractors will be required to pay the Standard Rate of Wages recognized in the District.

Tenders, endorsed "Contract No. 7, 8, &c.," as the case may be, addressed to the Chairman of the Gas and Water Committee, to be sent to the undersigned on or before Ten a.m. Friday, the 25th of May, 1900.

The Committee do not bind themselves to accept the lowest or any Tender.

Walter H. Morgan,
Clerk.

Council Offices, Pentre, R.S.O.,
Glam., May 12, 1900,

COUNTY BOROUGH OF BLACKBURN.

(Gas Department.)

THE Gas Committee invite Tenders for the Surplus TAR made at their Works during the Year ending the 30th of June, 1901.

The estimated Quantity is 2600 Tons; and Tenders are to state a price for same delivered into Tank-Waggons at the new Gas-Works Sidings, Greenbank.

Forms of Tender may be obtained from the undersigned, and to be delivered in sealed envelopes, endorsed "Tar," before Saturday, the 26th of May, 1900.

S. R. Ogden,
Engineer and Manager.

Gas Department,
Municipal Offices, Blackburn,
May 15, 1900.

TENTERDEN GAS COMPANY.

COAL.

TENDERS invited for supply of 500 Tons of best GAS COAL, delivered at the following Stations, Tenterden (Rother Valley Railway), Headcorn and Appledore (S.E.R.), 400 Tons to be delivered in June, July, and August next, and the remainder as and when required.

Tenders, with Analysis and full Particulars of the Coal offered, to be sent to me on or before Saturday, the 19th inst.

The lowest or any Tender not necessarily accepted.

Geo. F. Varty,
Secretary.

Tenterden,
May 8, 1900.

RHYL URBAN DISTRICT COUNCIL.

(Gas Department.)

THE Gas Committee are prepared to receive TENDERS for the supply of about 4600 Tons of screened GAS COAL, to be delivered at Rhyl Station in such quantities as may be required from the 1st of June, 1900, to the 30th of June, 1901.

Forms of Tender may be obtained on application to Mr. Leonard G. Hall, Gas Engineer.

Tenders, addressed to the Chairman of the Gas Committee, and endorsed "Tender for Coal," to be delivered on or before Monday, the 21st of May, 1900.

The Council do not bind themselves to accept the lowest or any Tender.

Arthur Rowlands,
Clerk to the Council.

Council Offices, Rhyl,
May 11, 1900.

THE Corporation of Middleton are prepared to receive TENDERS for the supply of 10,000 Tons of COAL (Screened and Nuts) and 3000 Tons of CANNEL, delivered at the Middleton Railway Station.

Further Particulars and Form of Tender may be obtained from Mr. T. Duxbury, Gas Engineer. One-half of the quantity of Coal and Cannel will be taken during the Summer Months.

Tenders, addressed to the Chairman of the Gas, &c., Committee, and endorsed "Tender for Coal or Cannel," to be delivered at my Office not later than Monday, the 21st of May, 1900.

The Corporation do not bind themselves to accept the lowest or any Tender.

Frederick Entwistle,
Town Clerk.

Town Hall, Middleton,
May 10, 1900.

SHEPPY GAS COMPANY.

TENDERS FOR GAS COAL.

THE Directors of the above Company invite TENDERS for the supply of about 800 Tons of the best DURHAM GAS COAL for Twelve Months ending June 30, 1901, in such quantities as may be required, to be delivered free alongside their Wharf at West Minster, near Sheerness.

Tenders should be accompanied by an Analysis, together with full Particulars of the Coal offered.

The Firm whose Tender is accepted will be required to enter into an Agreement with the Company for the due carrying out of their Contract.

Tenders to be sent to the undersigned by Wednesday, the 23rd of May, 1900.

The Directors do not bind themselves to accept the lowest or any Tender.

By order,
H. Barber,
Secretary.

Gas Offices, 2, Trinity Road,
Sheerness-on-Sea.

CITY OF BRADFORD.

TO COLLIERY PROPRIETORS AND OTHERS.

THE Gas Committee of the Bradford Corporation are prepared to receive TENDERS for the supply of Best GAS COAL, COBBLES, NUTS, and CANNEL, all to be well-screened, dressed, and free from Shale and Pyrites, to be delivered at the several works of the Corporation in the City during the period of One Year or of Two Years, commencing on the 1st day of July next, as may be agreed upon.

Form of Tender, with any further Information required, may be had on application to Mr. Wood, Gas Engineer, Town Hall.

Sealed Tenders, endorsed "Tender for Coal," to be sent to me on or before Wednesday, the 23rd of May inst.

Persons tendering must give an assurance that they have paid to their Workmen for the three months preceding date of Tender not less than the minimum Standard Rate of Wages, and undertake to continue to pay during the contract the same Rate of Wages.

The lowest or any Tender will not necessarily be accepted.

Frederick Stevens,
Town Clerk.

Town Hall, Bradford,
May 11, 1900,

MALTON GAS COMPANY.

TENDERS FOR COALS.

THE Directors invite Tenders for the supply of about 5000 Tons of GAS COALS, COBBLES, or NUTS, delivered at the North-Eastern Railway Company's Depôt, Malton, during the Year ending the 30th of June, 1901.

Payments will be made monthly.

Tenders to be sent in on or before Saturday, the 26th of May inst.

The Directors do not bind themselves to accept the lowest or any Tender.

Henry Tobey,
Secretary.

Malton, Yorks.

BOROUGH OF DARWEN.

TENDERS FOR GAS COAL.

THE Corporation are prepared to receive TENDERS for the supply of GAS COAL, for One, Two, or Three Years, to be delivered at the Gas-Works Siding in the Corporation Waggons.

Forms of Tender and all Information as to quantities may be obtained on application to Mr. A. H. Smith, Gas Engineer, Darwen.

Sealed Tenders, endorsed "Gas Coal," must be delivered to the undersigned at or before noon, Saturday, May 26, 1900.

No Tender necessarily accepted.

By order,
Chas. Costeker,
Town Clerk.

Town Clerk's Office, Darwen.
May 2, 1900.

BOROUGH OF DARWEN.

THE Corporation are prepared to receive TENDERS for all the surplus GAS TAR produced at their Gas-Works for One Year.

Also for the supply of the following Goods for One Year:—

(1) OILS and PAINTS.
(2) VITRIOL.
(3) WROUGHT-IRON TUBES and FITTINGS.
(4) CAST-IRON MAINS and SPECIALS.
(5) LEAD PIPE.

Particulars as to Quantities may be obtained on application to Mr. A. H. Smith, Gas Engineer, Darwen.

Sealed and endorsed Tenders must be delivered to the undersigned at or before noon, Saturday, May 26, 1900.

No Tender necessarily accepted.

By order,
Chas. Costeker,
Town Clerk.

Town Clerk's Office, Darwen,
May 2, 1900.

BOROUGH OF CHORLEY.

TO COLLIERY OWNERS AND OTHERS.

THE Chorley Corporation invite TENDERS for the supply of GAS COAL, CANNEL, and CANNEL CHIPPINGS required at their Gas-Works during a period of Twelve Months commencing the 1st of July next.

Forms of Tender and any further Information may be obtained on application to Mr. John M'Cubbin, Gas Manager, Chorley.

Tenders, endorsed "Coal," to be sent to me on or before Tuesday, the 22nd inst.

The Corporation do not bind themselves to accept any Tender.

By order,
Jno. Mills,
Town Clerk.

Town Hall, Chorley,
May 4, 1900.

SHREWSBURY GASLIGHT COMPANY.

TENDER FOR COAL.

THE Directors of the Shrewsbury Gas- light Company, invite TENDERS for the supply of about 15,500 Tons of screened GAS COALS, to be delivered free at the Great Western or London and North-Western Goods Yard, Shrewsbury, during the Year commencing July 1, 1900, and ending June 30, 1901.

The Directors reserve to themselves the right to divide the quantity into two or more Contracts, and do not bind themselves to accept the lowest or any Tender.

Tenders must be made on Forms (containing further Particulars), which may be obtained on application at the Company's Works, or by post, and must be sent to the undersigned, on or before the 24th day of May, 1900.

By order,
Wm. Belton, Assoc.M.Inst.C.E.,
Secretary and Manager.

Gas-Works, Shrewsbury,
April 28, 1900.

SCARBOROUGH GAS COMPANY.

AMMONIACAL LIQUOR.

THE Directors of the Scarborough Gas Company invite TENDERS for the whole of the AMMONIACAL LIQUOR, to be produced at their Works for One or more Years from the 1st day of July next.

Tenders may be submitted either at a fixed Price per Ton or on a Sliding-Scale, regulated by the price of Sulphate. Preference will, however, be given to the latter.

Further Particulars may be obtained on application to the undersigned.

Tenders (duly endorsed) must be delivered, addressed to the Chairman of the Company, not later than Noon, on Saturday, the 9th of June next.

The Directors do not bind themselves to accept the highest or any Tender.

By order,
J. Holliday,
Engineer and Secretary.

Gas Offices: 32, Westborough,
Scarborough, May 16, 1900.

THE Directors of the Petworth Coal Gas and Coke Company invite TENDERS for the supply of 650 Tons of good GAS COAL, to be delivered free at Petworth Station, L.B. & S.C. Railway, when required, between June 30, 1900, and June 30, 1901.

Sealed Tenders, endorsed "Coal," to be sent to the Secretary, on or before Saturday June 2, 1900.

The Directors do not bind themselves to accept the lowest or any Tender.

No Tender Forms supplied.

C. H. DOWNS,
Secretary.

Petworth, May 16, 1900.

OSWALDTWISTLE URBAN DISTRICT COUNCIL.

TENDERS FOR GAS COAL.

THE Council invite Tenders for the supply of 4000 Tons of screened GAS COAL during the Twelve Months ending June 30, 1901.

Further Particulars may be obtained from the undersigned.

Sealed Tenders, endorsed "Tender for Gas Coal," to be sent to the undersigned, not later than the 30th of May inst.

BENJN. T. WESTWELL,
Clerk.

Town Hall, Oswaldtwistle,
(Lancs.), May 10, 1900.

THE Widnes Corporation are pre- pared to receive TENDERS for the supply of about 25,000 Tons of GAS COAL (Slack, "through and through"), for the period ending June 30, 1901, to be delivered at the Gas-Works, Widnes.

Condition and Forms of Tender may be obtained from Mr. I. Carr, M.Inst.C.E., Gas Engineer, Widnes.

Tenders, endorsed "Gas Coal," to be delivered to the undersigned not later than noon of Monday, the 28th of May inst.

The Corporation do not bind themselves to accept the lowest or any Tender.

H. S. OPPENHEIM,
Town Clerk.

Town Hall, Widnes,
May 10, 1900.

RADCLIFFE AND PILKINGTON GAS COMPANY.

TO CONTRACTORS AND OTHERS.

THE Directors of the above Company are prepared to receive TENDERS from experienced Contractors for the construction of a BRICK GASHOLDER TANK, 142 feet diameter and 30 feet deep.

The Drawings and Specification may be seen on application at the Gas-Works, and at the Office of Messrs. Thomas Newbigging and Son, Engineers, 5, Norfolk Street, Manchester.

Quantities and Form of Tender may be obtained from the latter on deposit of Three Guineas, to be returned on a *bonâ-fide* Tender being sent in.

Tenders, endorsed "Gasholder Tank, Contract No. 1," to be sent so as to reach me not later than noon on Tuesday, the 29th day of May, 1900.

The Directors do not bind themselves to accept the lowest or any Tender.

JAMES BRADDOCK,
Manager and Secretary.

Gas Office, Radcliffe,
May 10, 1900.

EXMOUTH GAS COMPANY.

TENDERS FOR GAS COAL.

THE Directors of the Exmouth Gas Company invite TENDERS for 3000 Tons of clean unscreened (through and through) first-class DURHAM or ANY OTHER GOOD GAS COAL, to be shipped in such quantities (by Sailing Vessels only), and at such times as may be required, commencing from the 1st of August next.

Tenders to be accompanied by practical Working Analysis, and Prices may be quoted c.i.f. or f.o.b. at Exmouth Docks.

Sealed Tenders to be sent to the undersigned, addressed to the Chairman of the Company, and endorsed "Tender for Coal," not later than Thursday, the 31st day of May.

The Directors reserve to themselves the right to accept the whole or any portion of any quantity offered, and do not bind themselves to accept the lowest or any Tender (no special Form of Tender issued).

By order,
JAMES T. FOSTER,
Secretary and Manager.

Gas-Works, Exmouth,
May 8, 1900.

GLOUCESTER GASLIGHT COMPANY.

TENDERS FOR GAS COAL.

THE Directors of the above Company invite TENDERS for the supply of about 30,000 Tons of GAS COAL for One Year from the 1st day of July next, in such monthly quantities as may be required by the Company.

Tenders to state the price delivered at the Midland Railway Wharf, High Orchard, or the Great Western Railway Wharf, Llanthony, Gloucester; or if sent (as preferred) by Water, the price f.o.b., and also the price delivered at the Gas Company's Wharf on the Gloucester and Berkeley Canal.

Further Particulars and Forms of Tender may be obtained of the undersigned.

Sealed Tenders, endorsed "Tender for Coal," specifying the description and quality of the Coal, to be addressed to the Chairman, Gas Offices, Eastgate Street, Gloucester, and delivered not later than the 4th day of June next.

The Directors reserve to themselves the right to accept the whole or any portion of any quantity offered, and do not bind themselves to accept the lowest or any Tender.

By order,
WILLIAM E. VINSON,
Secretary.

Gas Offices, Gloucester,
May 3, 1900.

THE Directors of the Clevedon Gas Company are open to receive TENDERS for the whole or part of 4000 Tons of best screened GAS COAL, delivered free on Rails, Clevedon Station, as required during Twelve Months ending June 30, 1901.

Sealed Tenders to be addressed to the undersigned on or before May 30 inst.

Sample Trucks to be supplied at Contract Prices if required.

The Directors do not bind themselves to accept the lowest or any Tender.

J. HARGER PYE,
Engineer and Manager.

Gas Company, Clevedon,
Somerset.

THE URBAN DISTRICT COUNCIL OF PADIHAM.

(GAS DEPARTMENT.)

TENDERS FOR ENGINE AND EXHAUSTER, &c.

THE Gas Committee invite Tenders for the supply and erection of an ENGINE and EXHAUSTER; also two additional COLUMNS to the Condensers at their Gas-Works, Inskip Street, Padiham.

Full Particulars may be obtained on application to the undersigned.

Sealed Tenders, marked "Tender for Engine and Exhauster," or "Tender for Condensers," and addressed to the Chairman of the Gas Committee, must be sent to me on or before the 26th day of May inst.

J. R. SMITH,
Clerk.

Council Offices, Padiham,
May 12, 1900.

ULVERSTON URBAN DISTRICT COUNCIL.

TENDERS FOR COAL AND CANNEL.

THE Gas and Water Committee invite TENDERS for the supply of Best Screened GAS COAL AND CANNEL for One, Two, or Three Years, commencing the 1st of July next.

Parties tendering must give full Particulars of the Coal and Cannel they propose to supply, and name the Pit from which the same will be raised.

Further Information and Forms of Tender may be obtained on application to the undersigned.

Sealed Tenders to be sent in not later than the 31st inst., addressed to the Chairman of the Gas and Water Committee, and endorsed "Tender for Coal or Cannel."

The Committee do not bind themselves to accept the lowest or any Tender.

JNO. SWAN,
Engineer and Manager.

NEWTON-IN-MAKERFIELD URBAN DISTRICT COUNCIL.

TENDERS FOR COAL AND CANNEL.

THE Urban District Council of Newton- in-Makerfield invite TENDERS for the supply of GAS COAL and CANNEL, as may be required at their Gas-Works for a period of One Year from June 1, 1900, to May 31, 1901, to be delivered at Earlestown Railway Station (L. & N.W.), free of carriage.

Form of Tender may be obtained from the undersigned.

Tenders, endorsed "Gas Coal" or "Cannel," addressed to the Chairman of the Gas Committee, to be delivered at my Office not later than the 19th of May, 1900.

The Council do not bind themselves to accept the lowest or any Tender.

W. W. SHIRLEY,
Clerk to the Council.

Clerk's Office, Town Hall, Earlestown,
May 3, 1900.

BOROUGH OF SMETHWICK.

THE Gas Committee invite Tenders for PAINTING GASHOLDERS, PURIFIERS, and other IRONWORK at their Gas-Works situated at Rabone Lane, Smethwick, in accordance with the Specification, copy of which may be obtained on application to Mr. B. W. Smith, at the Gas-Works.

Separate Tenders will be required (*a*) for Paint only, mixed ready for using, and (*b*) for providing the Labour and necessary Tools and Plant for execution of the Work.

Contractors will be required to pay the Standard Rates of Wages recognized in the District.

Tenders, endorsed "Tender for Painting," addressed to the Chairman of the Gas Committee, to be delivered to the undersigned not later than the 24th of May next.

The Committee do not bind themselves to accept the lowest or any Tender.

By order
(Signed) W. J. STURGES,
Secretary.

Gas Offices, Town Hall,
Smethwick.

TENDERS FOR GAS COALS.

THE Brentwood Gas, Coke, and Light Company, Limited, invite TENDERS for the supply of about 4500 Tons of DURHAM or Best Unscreened SILKSTONE GAS COALS, to be delivered in Trucks at Brentwood Railway Station (G.E.R.) during the period of Nine Months between June 1, 1900, and Feb. 28, 1901, in quantities from time to time as required.

The Directors reserve the right to accept Tenders for the whole or any portion of the quantity offered, and do not bind themselves to accept the lowest or any Tender.

Tenders, with Analysis of the Coal, to be supplied and Terms for monthly payments to be sent to the undersigned on or before the 21st inst. Payment will only be made on the quantities delivered over the Weigh-bridge belonging to the Great Eastern Railway Company at this Station.

Forms of Tender not supplied.

C. A. FIELDER,
Secretary.

Brentwood, Essex.,
May 4, 1900.

THE East Dereham Urban District Council are prepared to receive TENDERS for the supply of about 1300 Tons of GAS COAL for the ensuing Year.

Conditions and Forms of Tender to be had of the undersigned.

Tenders to be sent in by the 6th of June, 1900, to

B. H. VORES,
Clerk to Urban District Council.

East Dereham.

THE Directors of the Ware Gaslight and Coal and Coke Company, Limited, invite TENDERS for the supply of from 1600 to 2400 Tons of BARROW, SILKSTONE, and EAST PONTOP GAS COALS, to be considered at their Meeting to be held on Tuesday, the 5th day of June, 1900.

Full Particulars may be obtained on application to me the undersigned at my Office.

By order of the Board,
GEO. H. GISBY,
Secretary.

Town Hall, Ware, Herts.

TENDERS FOR COAL.

THE Directors of the Holyhead and North Wales Gas and Water Corporation, Limited, are prepared to receive TENDERS for the supply and delivery of COALS to their various Works for the ensuing year.

Full Particulars and Forms of Tender may be had on application to the undersigned, to whom sealed Tenders, endorsed "Tender for Coal," must be sent not later than Twelve noon, Monday, May 21, 1900.

GEORGE E. SAVILLE,
Managing Director.

Conway Road, Penmaenmawr,
May 9, 1900.

FARNWORTH AND KEARSLEY GAS COMPANY

TENDERS FOR COAL AND CANNEL.

THE Directors of this Company invite TENDERS for the supply of COAL and CANNEL for delivery between the 1st of July, 1900, and the 30th of June, 1901.

Forms of Tender and Specification can be had from the undersigned.

Sealed Tenders to be addressed to the Chairman, J. W. Watkinson, Esq., and to be delivered on or before the 30th of May next.

THOS. LEA SHEPPARD,
Manager.

Gas Offices, Farnworth,
May 9, 1900.

BOROUGH OF WARRINGTON.

(GAS DEPARTMENT.)

THE Gas Committee invite Tenders for the following—viz.,

1. 30,000 Tons of GAS COAL.
2. 50 Tons of CEMENT.
3. 500 SLEEPERS.

Full Particulars can be obtained on application to Mr. W. S. Haddock, Engineer to the Works.

Sealed Tenders, endorsed, addressed to the Chairman, Gas Committee, Gas Offices, Warrington, must be sent in not later than the 25th inst. for Coal, and the 18th inst. for Cement and Sleepers.

FREDK. TAYLOR.

Gas Offices, Warrington,
May 11, 1900.

ROTHERHAM CORPORATION.

COAL CONTRACTS.

THE Gas Committee invite Tenders for the supply and delivery at the Gas-Works, Frederick Street and Drummond Street, Rotherham, of

25,000 TONS OF BEST SCREENED GAS COAL.
2,500 TONS OF GOOD CANNEL COAL.

Form of Tender may be obtained upon application to the Secretary at the Gas-Works.

Sealed Tenders, to be sent to me not later than the 22nd inst., endorsed "Tender for Coal," or "Cannel," as the case may be.

By order,
H. H. COPNALL,
Town Clerk.

Council Hall, Rotherham,
May 10, 1900.

MANSFIELD CORPORATION.

(GAS DEPARTMENT.)

TENDERS FOR GAS COAL AND CANNEL.
TENDERS FOR TAR AND AMMONIACAL LIQUOR.

COAL.

THE Gas Committee are prepared to receive TENDERS for 2000 Tons of CANNEL and 8000 Tons of best screened GAS COAL, delivered at Mansfield Station, for One Year from the 1st of June, 1900, to the 31st of May, 1901.

TAR AND LIQUOR.

Tenders for surplus TAR and LIQUOR made during the Year, from the 1st of July, 1900, to the 30th of June, 1901. Tenders for Liquor to be made either at a fixed price per Ton or on the Sliding-Scale regulated by the price of Sulphate.

Tenders, endorsed "Coals," to be sent to J. Harrop White, Esq., Deputy Town Clerk, Mansfield, on or before the 25th of May, 1900.

Particulars and all other Information from the undersigned.

No special Form of Tender provided.

The Committee do not bind themselves to accept the lowest or any Tender.

ARTHUR GRAHAM,
Engineer and Manager.

Gas-Works, Mansfield,
May 2, 1900.

SALES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

MR. ALFRED RICHARDS begs to notify that his AUCTIONS of STOCKS and SHARES in London, Suburban, and Provincial Gas and Water Companies are held PERIODICALLY, at the Mart, Tokenhouse Yard, E.C.

He also undertakes the issuing by AUCTION of GAS and WATER STOCKS and SHARES under Parliamentary Powers.

Terms for issuing such Capital, and also for including Gas and Water Stocks and Shares in these periodical Sales, can be obtained on application at Mr. ALFRED RICHARDS' OFFICES, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the

PLYMOUTH AND STONEHOUSE GAS COMPANY.

NEW ISSUE OF £4500 ORDINARY STOCK.

MR. ALFRED RICHARDS will Sell THE ABOVE BY AUCTION, at the Mart, E.C., on Wednesday, May 23, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the

MAIDSTONE GAS COMPANY.

£10,370 THREE PER CENT. PERPETUAL DEBENTURE STOCK.

MR. ALFRED RICHARDS will Sell THE ABOVE BY AUCTION, at the Mart, E.C., on Wednesday, May 23, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Executors of the late W. H. H. Broadberry, Esq.

MR. ALFRED RICHARDS will Sell BY AUCTION, at the Mart, E.C., on Wednesday, May 23, at Two o'clock,

GAS AND WATER STOCKS AND SHARES

OF THE

TOTAL CAPITAL VALUE OF ABOUT £4000,

IN THE

Tottenham and Edmonton Gas Company, Southend Gas Company, West Surrey Water Company, Barnet District Gas and Water Company, Romford Gas and Coke Company, Horley District Gas Company, Woking Water and Gas Company, Harrow and Stanmore Gas Company, Waltham Abbey and Cheshunt Gas Company, Colney Hatch Gas Company, Buntingford Gas Company, St. Margaret's Gas Company, and the South African Lighting Association.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the

CRAWLEY GAS COMPANY, LIMITED.

THE FREEHOLD GAS-WORKS SITUATE AT CRAWLEY, SUSSEX.

Conveniently placed close to the Main Road, within about half-a-mile of Crawley Station on the London, Brighton, and South-Coast Railway, and comprising Retort-House (with Nine Retorts), Two Gasholders, Purifiers, Scrubber, Coal-Store, Lime-Shed, Tar-Well, Meter and Governor House, Manager's House, together with the Mains to a length of about 3½ miles, Meters, Services, and Tools. The whole to be sold as a going concern, and with possession on completion.

MR. ALFRED RICHARDS will Sell THE ABOVE BY AUCTION, at the Mart, Tokenhouse Yard, E.C., on Tuesday, June 12, 1900, at Two o'clock, instead of May 23, as previously announced.

Particulars of the SECRETARY of the Company, at the Offices, High Street, CRAWLEY; of MESSRS. HOLMES, LEAR, AND BELDAM, Solicitors, ARUNDEL; and of Mr. ALFRED RICHARDS, Auctioneer, 18, FINSBURY CIRCUS, E.C.

SOUTH STAFFORDSHIRE WATER-WORKS COMPANY.

ISSUE OF £59,300 NEW FIVE PER CENT. PREFERENCE STOCK, CLASS "E," BY PUBLIC TENDER.

THE ACT OF PARLIAMENT EMPOWERS TRUSTEES TO INVEST TRUST FUNDS IN THIS STOCK.

THE Directors Hereby Give Notice, that in accordance with the Provisions of the South Staffordshire Water-Works, Act, 1893, they are prepared to issue the above-mentioned amount of PREFERENCE STOCK, in lots of £100 each.

The Holders of the Stock will be entitled to Dividend, payable Half-Yearly, at the rate of, but not exceeding, £5 per centum per annum out of the Profits of the Undertaking in each Year. Tenders may be made for any number of lots of £100 each.

Forms of Tender may be obtained on application to the Secretary, at the Office of the Company, in Paradise Street, Birmingham, on and after Thursday, the 10th day of May, 1900; and the latest day for receipt of Tenders is fixed for Friday, the 8th day of June, 1900.

Notices of Allotment will be sent out by the Company on or before Monday, the 11th day of June, 1900; and the date for payment of the whole amount to the Company's Bankers is fixed for Saturday, the 30th day of June, 1900, after which day the Stock will rank for Dividend.

The allotments will be made and Certificates will subsequently be issued free of all expense to the Allottees, who will thus acquire the Stock without payment for Stamps, Commission, or Fees of any kind.

By order,

H. HASELDEN,
Secretary.

Paradise Street, Birmingham,
May 9, 1900.

WORTHING GAS COMPANY.

THE Directors are prepared to borrow on Mortgage of the Company's Undertaking £3200 in sums of not less than £500, bearing Interest at 3½ per cent. per annum, payable Half Yearly.

Lenders to be entitled to repayment at any time on Six Months' Notice; the Company not to pay off until the 29th day of January, 1908. Present Subscribed Stock and Share Capital £69,481.

For further Particulars apply to

W. F. VERRALL,
Secretary.

55, Chapel Road, Worthing.

HARROGATE GAS COMPANY.

SALE BY TENDER OF £10,000 FOUR PER CENT. PREFERENCE STOCK.

THE Directors of this Company are prepared to receive TENDERS for the Whole or any portion, not being less than £10 or a multiple thereof, of the above-named £10,000 FOUR PER CENT. PREFERENCE STOCK.

Particulars of the same, with Form of Tender, can be obtained at this Office on application to the undersigned.

Tenders to be sent in not later than Twelve o'clock noon on Thursday, the 24th day of May, 1900.

By order,

H. WILKINSON,
Secretary and General Manager.

Gas Offices, Harrogate,
April 27, 1900.

TO CAPITALISTS AND TRUSTEES.

RELIABLE SECURITIES.

CROMER GAS COMPANY.

NEW ISSUE OF STOCK.

MESSRS. ROBERT BALDRY & SON are favoured with instructions from the Directors, to SELL BY AUCTION, at the Royal Hotel, Norwich, on Wednesday, the 23rd day of May, 1900, at Three for Four o'clock in the Afternoon, the following STOCK of the above Company—viz.,

£4000 ORDINARY STOCK,

AND

£1000 DEBENTURE STOCK,

In Lots of £50 each; the purchaser of one Lot to have the option of taking one to three more Lots at the like price.

Full Particulars and Conditions of Sale may be obtained ten days prior to date of Sale, of the Auctioneers, Tombland, Norwich, and at the Office of the Company, Church Street, Cromer.

P. E. HANSELL,
Secretary.

THOMAS DUXBURY & CO.,
16, DEANSGATE, MANCHESTER.
GAS ENGINEERS' AGENTS AND CONTRACTORS FOR
Meters, Fire-Clay Goods, Oxide of Iron, and all other Gas Apparatus. Retort Carbon purchased.
Inquiries Solicited.
Telegrams: "DARWINIAN, MANCHESTER. Telephone 1806.

COKE-BREAKERS,
PRICES REDUCED.
(THOMAS & SOMERVILLE'S PATENT)
With Elevators and Conveyors worked by Steam or Gas Engine.
GEORGE WALLER & CO.,
165, QUEEN VICTORIA STREET, E.C.;
And at STROUD, GLOUCESTERSHIRE.

UNEQUALLED.
Gas Companies are solicited to try Samples of the
MIRFIELD
BLACK BED GAS COAL.
Prices and Analysis on application.
MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, NEAR DEWSBURY.

NEWBATTLE CANNEL.
Highest Results in Gas, & Excellent Coke.
QUOTATIONS ON APPLICATION TO
THE LOTHIAN COAL COMPANY,
LIMITED,
NEWBATTLE COLLIERIES,
DALKEITH N.B.

HEATHCOTE GAS COAL.
Rich in Illuminating Power and Yield of Gas.
Above the Average in Weight and Quality of Coke.
Maintains a High Standard in Residuals.
THE GRASSMOOR CO., LD.,
CHESTERFIELD.

HARDMAN & HOLDEN, LD.
ESTABLISHED 1820.
SULPHURIC ACID.
GUARANTEED absolutely free from Arsenic and of excellent Purity. Specially prepared for Sulphate of Ammonia Manufacturers.
Works: BLACKBURN; Miles Platting and Clayton, MANCHESTER.
Head Office: Miles Platting, MANCHESTER.
Inquiries Solicited.

JAMES OAKES & CO.
ALFRETON IRON-WORKS, DERBYSHIRE,
AND
Wenlock Iron Wharf, 21 & 22, Wharf Road, CITY ROAD, LONDON, N.,
Manufacture and keep in Stock at their Works (also large stock in London)
PIPES and CONNECTIONS, 1¼ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.
NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with Bolts, Nuts and Covers, and rendering Leakage impossible.

HOLMSIDE
GAS COALS.
Present Daily Produce over 5000 Tons.
Latest Analysis—By CHARLES PHILLIPS, Gas Examiner to Rotherham Corporation

Yield of Gas per Ton . . .	11,205 Cubic Feet.
Illuminating Power	16 7/10 Stand. Sperm. Candl.
Coke (of good & pure quality)	13¾ Cwt. per Ton.
Sulphur	A little over 1 per Cent.
Ash	Under 1 per Cent.
Tar	163 lbs. (Avoir.) per Ton.
Ammoniacal Liquor	103 lbs. (Avoir.) per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR
PELTON GAS COALS.
Present Daily Produce available 3000 Tons.
Of equal quality to the "Holmside" Coal, and also very largely used by many Gas Companies at Home and Abroad.
Both descriptions are shipped at Tyne Docks, and Dunston Staiths, River Tyne, also at North and South Docks, Sunderland.
These Coals may be bought through the Principal Merchants in England, or direct from
MR. MARK ARCHER,
HOLMSIDE & SOUTH MOOR OFFICES,
NEWCASTLE-UPON-TYNE.

LONDONDERRY GAS COALS

FROM THE

LONDONDERRY COLLIERIES,

COUNTY OF DURHAM.

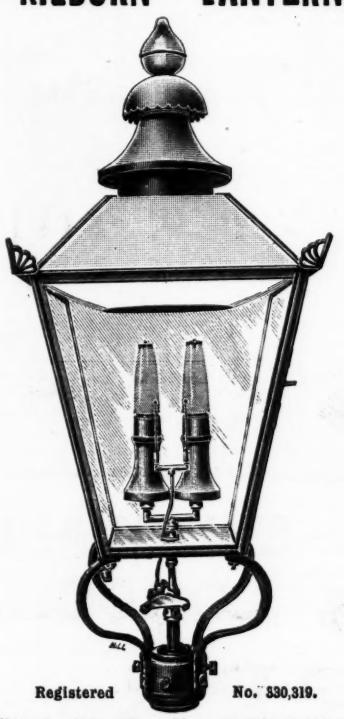
Available Output up to 5000 Tons per day.
Yield of Gas 11,000 cubic feet per Ton of Coal
as per Analysis by
Mr. John Pattinson, F.C.S., F.I.S.

FOR PRICES AND PARTICULARS, APPLY TO

S. J. DITCHFIELD,
SEAHAM HARBOUR,
COUNTY OF DURHAM.

THE

"KILBURN" LANTERN.



Registered No. 330,319.

Fitted with Steel Enamelled White Reflector.

H. GREENE & SONS, LTD.
19, FARRINGDON ROAD, E.C.
Telephone: 1215 HOLBORN. Telegrams: "LUMINOSITY."

NITRATE of Thorium and Cerium.
FABRIK CHEMISCHER PRAEPARATE VON STHAMER, NOACK, AND CO., HAMBURG.

DISPENSE WITH CANNEL COAL
and
INCREASE YOUR ILLUMINATING POWER
by using the
WHESSOE-MUNICH BENZOL CARBURETTER
The Cheapest and Best in the Market.
The Managers of Tynemouth, Middlesbrough, and Darlington Gas-Works are much pleased with it, and would not be without it.
Apply to the Sole Makers:
THE WHESSOE FOUNDRY COMPANY, LIMITED, DARLINGTON.

THOMAS TURTON
AND SONS, LIMITED,
SHEAF WORKS, SHEFFIELD,
MANUFACTURERS OF
FILES OF BEST QUALITY
FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES,
SPANNERS, RATCHET BRACES, LIFTING JACKS,
ANVILS, VICES,
AND ENGINEERS' TOOLS GENERALLY.
LONDON OFFICE:
90, CANNON STREET, E.C.

WELDON MUD
FOR
GAS PURIFICATION,
For use in the
RECOVERY OF SULPHUR,
ALSO
Removal of last Traces of SULPHURETTED HYDROGEN in catch position.

Full Particulars on application to the Patentees:
GAS DESULPHURIZATION CO.,
— LIMITED. —
1, FENCHURCH AVENUE, LONDON, E.C.

HOT WATER INSTANTLY.
NIGHT OR DAY.
Hot Bath when wanted.
Boiling Water in a Minute.
EWART'S
'LIGHTNING' GEYSER
For Gas or Oil.
346, EUSTON ROAD, LONDON.
Illustrated Price List Free.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887,
for
CANNEL & COAL.

TYNE
BOGHEAD CANNEL.

Yield of Gas per ton	13,155 cub. ft.
Illuminating Power	38·22 candles.
Coke per ton	1,501·83 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	17·8 candles.
Coke	70 per cent.

SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	73·1 per cent.

For Prices and complete Analysis, apply to
THOS. W. DANCE, SON, & HUNTER
COAL OWNERS, NEWCASTLE-ON-TYNE;
OR
E. FOSTER & CO.,
21, JOHN STREET, ADELPHI, LONDON, W.C.

MOBBERLEY & PERRY
STOURBRIDGE.
Manufacture & supply best quality of
Gas Retorts (SEGMENTAL, HORIZONTAL, or INCLINED.)
Special Bricks & Blocks for GENERATOR & REGENERATOR FURNACES.
FIRE BRICKS, LUMPS, & TILES, BLUE STAFFORDSHIRE VITRIFIED BRICKS FOR PAVING, &c, &c.
EVERY REQUISITE FOR GAS-WORKS. Retort Setters sent to any part of the Kingdom.
London Agents: Contractors for the erection of Retort-Benches complete.
BALE & HARDY. Gas Engineers and Contractors, BRIDGE HOUSE, 181, QUEEN VICTORIA STREET, E.C.

BOLDON GAS COALS.

Yield of Gas per Ton.	10,500	Cubic Feet.
Illuminating Power	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

As per Analysis by
Mr. JOHN PATTINSON, F.I.C., F.C.S.

For Prices, &c., apply to
W. H. PARKINSON,
THE HARTON COAL CO., LTD.,
NEWCASTLE-ON-TYNE.

Telegraphic Address: "PARKINSON, NEWCASTLE."

THE SILICA FIRE-BRICK COMPANY,

OUGHTIBRIDGE, near SHEFFIELD,
MANUFACTURE
SILICA BLOCKS, BRICKS, AND CEMENT
OF SUPERIOR QUALITY
FOR GAS-FURNACES.

Trade Mark: "SILICA."

These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their
GREATER DURABILITY,
Strongly recommended where EXCESSIVE HEATS have to be maintained.

THORNLEY GAS COALS

WORKED BY THE
WEARDALE IRON & COAL Co., Ld.
OUT OF THEIR
THORNLEY AND WHEATLEY HILL COLLIERIES.

Analysis made by
Messrs. J. & H. S. PATTINSON.

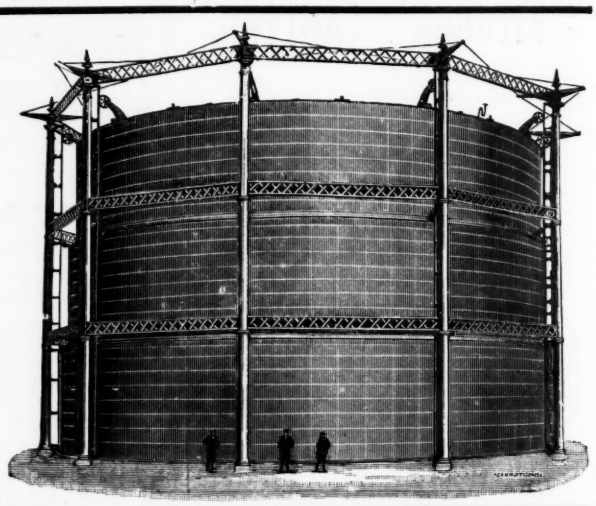
Yield of Gas per Ton	10,500 Cub. Ft.
Illuminating Power	16·9 Candles.
Coke (of good quality)	67·5 per Cent.
Sulphur	0·58 ,,
Ash	2·73 ,,

For Price, &c., apply to the
WEARDALE IRON & COAL Co., Ld.
QUAYSIDE, NEWCASTLE-ON-TYNE.

HANNA, DONALD, & WILSON,

(Established 1851),
GAS ENGINEERS & CONTRACTORS,
ABERCORN FOUNDRY AND ABBEY WORKS,
PAISLEY, N.B.,
MAKERS OF
Gasholders & Gas Plant
OF EVERY DESCRIPTION.

Telegraphic Address: "Donald, Paisley."



S. CUTLER AND SONS, MILLWALL, LONDON.

GASHOLDERS

OF EVERY SIZE AND DESCRIPTION

CUTLER'S PATENT GUIDE-FRAMING HAS BEEN ADOPTED FOR MANY IMPORTANT HOLDERS.

Carburetted Water-Gas Plant.

SPECIAL DESCRIPTIVE CATALOGUE ON APPLICATION.

PATENT WATER-TUBE CONDENSER

Over 120 now in use.

Cutler's Patent Freezing Preventer

For keeping Cups of Gasholders free from Ice.

CHARLES HUNT PATENT GAS-WASHER.

THE

DELLWIK-FLEISCHER WATER-GAS PROCESS

FOR

Increasing the Capacity of Coal-Gas Works

ALSO FOR

Incandescent Lighting and Manufacturing Purposes

(PATENTS IN ALL COUNTRIES).

Plants contracted for within the last Eighteen Months for the following Gas-Works :—

KÖNIGSBERG	ISERLOHN	LYONS	BRUMMEN*
ERFURT	REMSCHEID	BERNE	OSTERFELD*
PLAUEN	PFORTSHEIM	NUREMBERG	WARSTEIN*
	BARMEN-RITTERSHAUSEN		WIBORG*

* Blue Water Gas with Incandescent Burners.

ALSO TWENTY-FIVE INSTALLATIONS FOR MANUFACTURING PURPOSES.

THE DELLWIK-FLEISCHER WATER-GAS SYNDICATE,

25, VICTORIA STREET, WESTMINSTER, LONDON, S.W.

HARRIS & PEARSON,

STOURBRIDGE, ENGLAND.

MANUFACTURERS OF

FIRE-CLAY GAS-RETORTS, FIRE-BRICKS, LUMPS, & TILES of Every Description.

GLAZED BRICKS AND PORCELAIN BATHS.

THE WIGAN COAL & IRON CO., LIMTD.,

Are exclusive Owners of the well-known HAIGH HALL & KIRKLESS HALL GAS COAL COLLIERIES, and supply the Best Wigan Arley Mine Gas Coal, Gas Nuts, Gas Cannel, Cannel Nuts, &c.

Midland and West of England District Office: 6, CORPORATION STREET, BIRMINGHAM—Sole Agent: A. C. SCRIVENER.

Telegraphic Address: "WIGAN, BIRMINGHAM." Telephone No. 200.

London District Office: 6, STRAND, LONDON—C. PARKER & SON, Sole Agents.

Telegraphic Address: "PARKER, LONDON."

WE EXHIBIT AT THE PARIS EXHIBITION OUR INCLINED RETORT SYSTEM.

MAURICE GRAHAM. Telegrams "ACCOUPLE" LEEDS.

GRAHAM, MORTON & Co. LTD.

CONTRACTORS TO H.M. GOVERNMENT.

SEE OUR ILLUSTRATED CATALOGUE

ELEVATORS & CONVEYORS

Works; BLACK BULL STREET, LEEDS.

WE EXHIBIT AT THE PARIS EXHIBITION OUR INCLINED RETORT SYSTEM.

THE

"KITSON" LIGHT

A REVOLUTION IN LIGHTING.

Highest Award, Medal and Diploma

OF THE

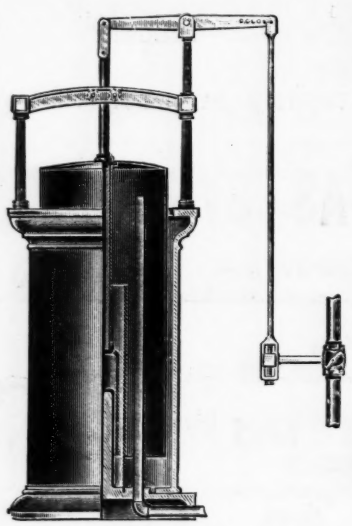
NATIONAL EXPORT EXPOSITION, PHILADELPHIA, U.S.A.

FOR PRICES AND PARTICULARS, APPLY TO THE

KITSON LIGHTING & HEATING SYNDICATE, Ld.

1, VICTORIA EMBANKMENT (New Bridge Street), LONDON, E.C.

REGISTERED OFFICE: 137, Victoria Road, DARLINGTON.



Hydraulic Steam-Regulator

PATENT

for Controlling the supply of Steam to the Engine driving Exhauster according to the make of Gas.

The peculiar construction makes it impossible for the Regulator to work other than gradually, as liquid has to pass in or out of a small hole as the Bell rises and falls.

JAMES MILNE & SON, LTD.

EDINBURGH.

LONDON. GLASGOW. LEEDS.

LONDON OFFICE:

TELEGRAPHIC ADDRESS: "DRAKESON, HALIFAX."

34, VICTORIA ST., WESTMINSTER, S.W.

TELEPHONE No. 43 "HALIFAX EXCHANGE."

GAS ENGINEERS. CONTRACTORS. IRONFOUNDERS.

JONAS DRAKE & SON

SOLE AGENTS FOR

HISLOP'S

PATENT REGENERATIVE FURNACES

— FOR —

ENGLAND, WALES & ABROAD.

RETORT BENCHES ERECTED COMPLETE WITH OR WITHOUT SPECIAL FURNACES. RESULTS GUARANTEED.

OVENDEN HALIFAX

RETORT SETTERS. FURNACE BUILDERS. ETC. ETC.

Designs and Estimates on Application.

GASEOUS FIRING A SPECIALTY.

INCLINED RETORTS

We Undertake Contracts for Complete
Installations of **INCLINED RETORT-BENCHES,**
with all the Latest Improvements,
as Erected by us at

CHESTERFIELD,

and declared by Experts to be
THE MOST SATISFACTORY INSTALLATION
working in

ENGLAND.

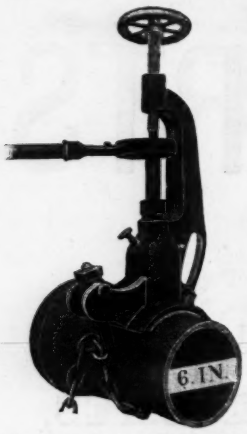
INSTALLATIONS ERECTED FREE FROM ROYALTIES.

R. DEMPSTER & SONS, LIMITED,

ELLAND, YORKS.

Telegraphic Address:
"DEMPSTER, ELLAND."

Telephone:
ELLAND No. 8.



TAPPING MACHINES
FOR
Drilling & Tapping
PIPE UNDER PRESSURE WITHOUT ANY ESCAPE OF GAS.

Combination Drills and Taps from ½ to 4 inches.

ADOPTED BY PRINCIPAL GAS COMPANIES THROUGHOUT THE UNITED STATES.

SEND FOR CATALOGUE.

Manufactured by GEORGE LIGHT, Dayton, OHIO, U.S.A.

THOMAS BUGDEN,
Manufacturer of

Bellows for Inflating Gas-Bags. Made in various sizes.

Bellows made to inflate a 48-inch Bag under One Minute.

Miners' Woollen Jackets.

India-rubber Hose, Sheet, and Washers of every description, Leather Bands, Oils, &c., Diving and Wading Dresses, Waterproof Coats, Capes, and Sewer Boots.

Stokers' Mitts, from 14s. doz.

Special Air Tubing made for Gas Companies.

Gas-Bags for Mains.

71, GOSWELL ROAD, E.C., AND AT
256, PENTONVILLE ROAD, KING'S CROSS, N.

ARROL-FOULIS
Patent Automatic Machinery
FOR
DRAWING AND CHARGING GAS-RETORTS.

Full Particulars may be obtained from the Sole Makers,

SIR WILLIAM ARROL & CO., Limited,
GLASGOW.

[See Illustrated Advertisement, May 8, p. 1172.]

PETTIGREW'S PATENT
Sulphate of Ammonia Plant
ON THE CONTINUOUS SYSTEM

Is the newest in the Market, and is the outcome of practical experience in Sulphate Making.

Old Systems easily and cheaply converted.

ANY SIZE ERECTED COMPLETE AT HOME OR ABROAD.

Makers of Self-Emptying Saturators.

Write for Particulars, Testimonials, and References to

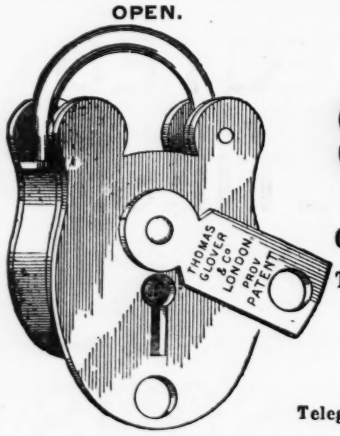
GEO. PETTIGREW & Co.,
GAS AND CHEMICAL ENGINEERS,
MIDDLESBROUGH-ON-TEES.

ESTABLISHED 1844. **ORIGINAL MAKERS.** ESTABLISHED 1844.

LONDON, 1851. NEW YORK, 1853. PARIS, 1855. LONDON, 1862. DUBLIN, 1865. PARIS, 1867.

THE SIX MEDALS AWARDED TO THOMAS GLOVER'S PATENT DRY GAS-METERS;
The latter being the Highest Award for Dry Gas-Meters at the Paris Exhibition, 1867. Since then we have not Exhibited FOR PRIZES.

OPEN.



THOMAS GLOVER & CO.'S
PATENT
SECURE PADLOCK
PREVENTS TAMPERING WITH THE
CASH-BOXES OF PREPAYMENT METERS.

The Padlock is Sealed by means of a Lead Eyelet, which is impressed with Company's private mark. Eyelets easily fixed and removed by Company's Collector.

CLOSED.

Telegraphic Address: "GOTHIC, LONDON." Telephone No. 725, Holborn.

THOMAS GLOVER & CO., LTD.,
DRY GAS-METER MANUFACTURERS,
214 to 222, ST. JOHN ST., CLERKENWELL GREEN, LONDON, E.C.

BRISTOL: 28, BATH STREET. *Telegraphic Address: "GOTHIC."* Telephone No. 1005.

BIRMINGHAM: 1, OOZELLS STREET. *Telegraphic Address: "GOTHIC"*

MANCHESTER: 37, BLACKFRIARS STREET. *Telegraphic Address: "GOTHIC."* Telephone No. 3898.

GLASGOW: 69-71, McALPINE STREET. *Telegraphic Address: "GASMAIN."* Telephone No. 6107

HARPER & MOORES,
STOURBRIDGE.

MANUFACTURERS OF
BEST FIRE-BRICKS, GAS-RETORTS,
LUMPS, TILES, AND ALL ARTICLES IN FIRE-CLAY.
Proprietors of Best Glasshouse Pot, Crucible, and other Stourbridge Clays.

Manufacturers of Glasshouse Pots and Crucibles of every kind.
Established 1836.

JOSEPH CLIFF & SONS,
INCORPORATED IN
THE LEEDS FIRE-CLAY COMPANY, Ltd.
WORTLEY, LEEDS.

LONDON OFFICES & DEPÔTS:
Baltic Wharf, Waterloo Bridge.
WHARVES NOS. 2 & 4, INSIDE G.N. GOODS YARD, KING'S CROSS, N.
LIVERPOOL:
16, Lightbody Street.
LEEDS:
Queen Street.

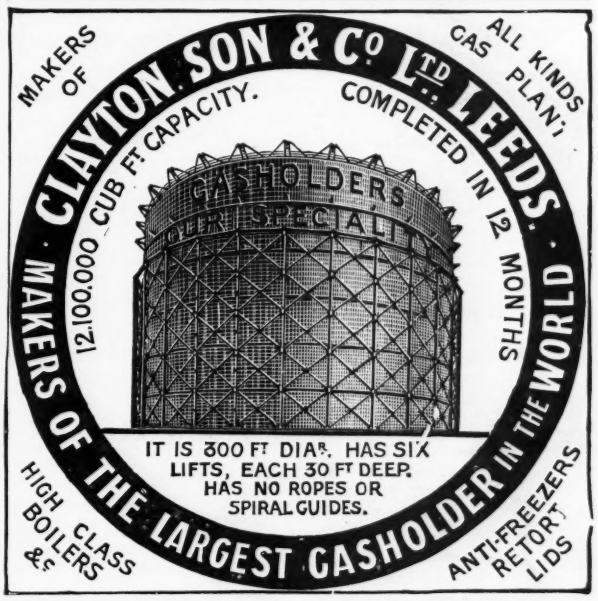
MACHINE-MADE RETORTS

Have been made in large quantities for the last twelve years; and during the whole of that time, have been in regular use at most of the largest Gas-Works in the Kingdom. They possess the excellent quality of remaining as near stationary as possible under the varying conditions of their work—a quality which will be appreciated by all Gas Engineers and Managers. The generally expressed opinion is that these Retorts are the very best that are made.

RETORTS CAREFULLY PACKED FOR EXPORT.
Fire-Bricks, Lumps, Tiles, &c., &c., of every description suitable for Gas-Works.

BOWENS' Ltd. Successors,
STOURBRIDGE.

MANUFACTURERS OF
BEST FIRE-BRICKS; INCLINED, HORIZONTAL, and SECTIONAL RETORTS; LUMPS, TILES, &c., of every description.
Established 1860.


MAKERS OF
CLAYTON, SON & Co LTD LEEDS.
ALL KINDS GAS PLANT
12,100,000 CUB FT CAPACITY.
COMPLETED IN 12 MONTHS
GASHOLDERS
OUR SPECIALITY
IT IS 300 FT DIAR. HAS SIX LIFTS, EACH 30 FT DEEP. HAS NO ROPES OR SPIRAL GUIDES.
MAKERS OF THE LARGEST GASHOLDER IN THE WORLD
HIGH CLASS BOILERS &c
ANTI-FREEZERS RETORT LIDS

GIRDERS, ROOFS, & ALL KINDS OF STRUCTURAL IRONWORK.

London Office: 60, QUEEN VICTORIA STREET, E.C.
Telegraphic Addresses: "GAS, LEEDS." "ECLARAGE LONDON."

R. & J. DEMPSTER, LTD.,

Telegraphic Address:
"SCRUBBER, MANCHESTER."
National Telephone: Nos. 54 and 2296.

MANCHESTER.

STEEL CYLINDRICAL TANKS.

4 Tanks 5 ft. dia., 16 ft. long.
1 do., 5 ft. do., 20 ft. do.
2 do., 6 ft. do., 24 ft. do.

SUITABLE FOR OIL, TAR, OR WATER.

TANKS / PUMPS — **READY FOR DELIVERY** — **ON STOCK.**

"DUPLEX" STEAM PUMPS.

	DIA. OF STEAM CYL.	DIA OF PUMP CYL.	STROKE.
1 Tar-Pump	9 in.	by 7 in.	by 10 in.
1 do.	9 in.	by 5¼ in.	by 10 in.
1 Water-Pump	9 in.	by 5¼ in.	by 10 in.
2 do.	5 in.	by 4¾ in.	by 5 in.
1 Tar-Pump	5 in.	by 4¾ in.	by 5 in.

FLY-WHEEL STEAM-PUMPS.
3 Tar-Pumps 9 in. by 5 in. by 9 in. Stroke.
1 Water-Pump 9 in. by 5 in. by 9 in. Stroke.

London Office: **165, Gresham House, Old Broad Street, E.C.**

W. PARKINSON & CO.

SQUARE STATION METERS.

PARKINSON'S PATENT EQUILIBRIUM GOVERNORS.

A very large number are now at work; and all Engineers who have adopted them speak in unqualified terms of their great efficiency.

COUNTERBALANCE or **AIR VESSEL**, as desired.
FITTED WITH SIX COLUMNS and **GIRDERS, WEIGHTS** or **WATER PRESSURE.**

COTTAGE LANE WORKS, CITY ROAD,
LONDON.
Telegrams: "INDEX."
Telephone No. 778 King's Cross.

BELL BARN ROAD WORKS,
BIRMINGHAM.
Telegrams: "GASMETERS."
Telephone No. 1101.

[See also Advt. p. 1270.

LONDON: Printed by WALTER KING (at the Office of King, Sell, and Railton, Ltd., 12, Gough Square); and published by him at 11, Bolt Court, Fleet Street, in the City of London.—Tuesday, May 15, 1900.